Electrical World

The consolidation of Electrical World and Engineer and American Electrician
Published by McGraw Publishing Company, Inc.

Vol. 61 NEW YORK, SATURDAY, FEBRUARY 8, 1913 No. 6

Patent Legislation

It has been announced in Washington that efforts to secure patent legislation during the present session of Congress will be dropped. The time is too short and the subject too intricate for thorough consideration until next winter. Other matters are engrossing Congress at present, and it is not likely that the extra session will provide suitable occasion to go into the matter properly. What could be done, and what ought to be done now to avoid further delay, is to appoint a competent non-partisan commission to conduct a thorough investigation and report a year hence. This program, which we have long urged, can easily be launched in the time remaining before the close of the session.

Co-operative Manufacturing

The decision handed down last Monday by the Supreme Court in the United Shoe Machinery case, it should be observed, covers very limited ground and does not bear at all upon the patent situation or the legality of the famous shoe-machinery leases. These leases were made after the consolidation of manufacturers took place in 1899, while the Supreme Court reviewed only the question, which came up to it on a writ of error from the Massachusetts District Court, whether two counts in the indictment charging the 1899 merger as unlawful ought to stand. The lower court threw out these two counts and is now sustained by the final authority, on the general ground that when two or more manufacturers who turn out different component parts of a fabricated product join together as one concern for the purpose mainly of economy there is no illegal restraint of trade involved. The propriety of the subsequent leases and the lawfulness of subsequent acts of the Shoe Machinery company, in the light of the Sherman act and the patent laws, were not under review in the present instance.

New York State Hydroelectric Scheme

The Conservation Commission of the State of New York is evidently determined to push legislation for a comprehensive scheme of hydroelectric development and high-tension transmission under state ownership and management. Inspiration for such a movement is found in the system of the Hydro-Electric Power Commission of Ontario, the Niagara division of which has been in successful operation for over a year. However, the New York scheme, which was outlined in these pages on Jan. 4, is open to legitimate engineering and commercial attack from all sides. For instance, it is proposed to transmit hydroelectric energy to New York City, and the nearest electrical development from which the energy can be derived is approximately 170 miles from the city. Even granting that the commission will have enough energy to make an impression on the New York market, no center like New York in the present state of the art can afford to depend exclusively on hydroelectric energy transmitted that distance. To-day the city of Buffalo is served over eight independent lines from Niagara Falls, 25 miles away, and notwithstanding the fact that these lines can be switched together in any way, the transmission company is unable to give absolutely continuous service. Moreover, it will be necessary for any municipality desiring to contract for state hydroelectrical energy to obtain a certificate of convenience and necessity from one of the public service commissions of the State. Where utilities already in existence are rendering efficient and reasonable service it is doubtful if a commission will permit competitive conditions; but should even this obstacle be overcome, the municipality will still be confronted with the problem of disposing of its bonds.

The Distribution of Producer Gas

An abstract of an important paper read before the British Institution of Civil Engineers recently describing a producer-gas plant unique in the history of the art in that it is designed for a general distribution of gas for power purposes alone is given in the *Digest* in this issue. The gas producer is an old acquaintance. Many plants have been installed for general power purposes or for purposes of electrical supply and fairly satisfactory results have been obtained. The present system bears the same relation to these casual producers that the great electric central station does to the isolated plant. The particular gas concern which is now under consideration is the South Staffordshire Mond Gas Company, utilizing eight 20-ton producers, seven of which are kept in regular use. No arrangement is made for storage, the speed of the blowers on the producers being modified to keep pace with the demand for gas, which passes from the producers through cooling and purifying apparatus and thence to steam-driven gas compressors delivering the gas at high pressure, about 5 lb. per sq. in., to the distributing mains. The thermal value of the fuel gas produced averages a little over 150 heat units per cu. ft., and the output at the peak of the load reaches the rate of 1,000,000 cu. ft. per hour. The area covered in the operation of the plant is 123 sq. miles and about 30 miles of mains are in regular use. Most of them are of steel in diameter from 36 in. down. The distribution of gas at high pressure for power and heating purposes is a thing long ago proposed and tried on a small scale, but in view of the present work projects of this kind from now on must be taken as serious enterprises. The South Staffordshire Company is selling gas at an

average price of 3.5 cents per 1000 cu. ft. and is said to be making money at that price. The output is used for production of power in gas engines and for various forms of heating, new uses being continually found for the product. Although as stated no storage is used in the system, yet a storage equipment could easily be added and it might in the long run prove advantageous in steadying the supply. Gas of the kind here distributed is equivalent in cost to the ordinary thermal value of lighting gas sold at about 14 cents per 1000 cu. ft. Reduced to an output basis this amounts to about ⅓ cent per hp-hr. when the gas is utilized in large engines running at fairly steady load.

It would be exceedingly interesting for someone to work out the application of such a system in connection with electrical distribution. It is hardly to be supposed that the small gas engine, even with cheap gas, can make much headway against the electric motor with fairly cheap energy supply, the engine losing in convenience more than it gains in economy. However, in cases where a large electrical distribution system is under way it is by no means impossible that fuel gas distributed at high pressure and utilized in large directly driven units for the operation of auxiliary stations might not prove economical and extremely convenient. Gas engines have been frequently suggested and tried as auxiliaries for hydroelectric installations, and where water-power is used to furnish part of the output of a central station, the possibility of locating gas auxiliaries at strategic points and supplying them with fuel from a single gas generating station is one well worth considering. Likewise in railway work where it is desired to use direct current on the motors the possibility of high-pressure gas distribution to feeding stations along the line as a substitute for overhead electrical transmission is certainly worth investigation. All electrical questions aside, so far as generation is concerned, the possibilities of a very cheap fuel gas supply for mere heating are worth serious consideration. Without attempting to forecast the future, since prophecy after the fact is the only safe kind, it does seem that the future city should be freed from the present smoke nuisance. And the distribution of fuel gas on a very large scale is the readiest means to this highly desirable end. Between fuel gas and electric service the city of half a century hence should be completely free from every sign of smoke, as free as some of the cities of the Middle West were during the best days of the natural-gas industry. Let the cheap fuel-gas supply come, for in the long run it will help a good deal more than harm the business of furnishing electrical energy.

Graphical Representation of Light Distribution

It frequently happens that in the course of evolution of some branch of exact science the later developments are out of sympathy with the earlier developments. This has happened, for example, in a number of branches of mathematics. Thus, the ordinary theory of modern arithmetic includes negative numbers, as well as positive numbers. Yet in the history of arithmetical development, according to Sir Robert Ball, the minus sign is not found until the fifteenth century; so that, although the process of subtraction was known much earlier than this, the notion of negative numbers came into existence later than this. The old arithmetic was not wrong; it was merely undeveloped. The new arithmetic includes and extends the old, the extensions having taken place dissymetrically and in unexpected directions.

When the science of illumination entered its quantitative stage of evolution, it started with a point source of light. Photometry began business with candles, which had to be fitted in to the scheme of point sources by a doctrine of equivalents. At a later stage the concept of luminous flux, with its unit the lumen, modified the entire theory. It came to be realized that luminous flux was a more natural and fundamental concept than candle-power, or luminous intensity. In the modern theory candle-power is no longer the primordial concept. It is the ratio of flux to the solid angle through which that flux is emitted. Nevertheless, the art and literature of the subject are so inextricably tied up with candles and candle-power that there is no immediate hope of changing the existing order of photometric things. The fundamental unit should be the lumen, and the intensity of a source should be stated in terms of the lumen, but law, custom and literature stand in the way.

In the article on page 297 Mr. R. F. Pierce attacks the term candle-power and seeks to substitute luminous flux in its place. The same numeric 4π intrudes into this proposal as in electromagnetic units. We think, however, that the consensus of qualified opinion will sympathize with him as to the desirability of the scientific order he advocates. On the other hand, it is very doubtful whether such a change is feasible at the present time. The article points out the misconceptions that a zonal-candle-power diagram may produce in untrained minds. Two ingenious polar diagrams are offered, by way of substitution—namely, one a polar diagram so drawn that its area over any angular distance measures the flux emitted by the source within the corresponding spherical angular zone, and the other a polar diagram such that the radius vector at any angle measures the integral of the area, on the first diagram, up to that angle. The first diagram is therefore designed to indicate the flux zonal distribution, as distinguished from the usual candle-power zonal distribution, while the second gives the total flux distribution from zenith to nadir.

The utility of the two new diagrams cannot be denied—but the exclusion of the regular zonal candle-power diagram is undesirable. In many practical cases the candle-power distribution curve is just what the engineer needs. The fact is that three quantities are ordinarily required in the graphical display of the photometric properties of any lamp, namely, (1) the usual zonal candle-power polar curve; (2) the flux distribution, zone by zone, and (3) the total flux between any assigned zonal limits, including the total flux emitted between zenith and nadir. According to the plan of Mr. Pierce one curve would be needed for each of these presentations, or three curves in all, because items (2) and (3) call for separate curves or halves of the sheet. Either the Rousseau diagram or the Kennelly diagram, appended to a polar candle-power diagram, presents items (2) and (3) conjointly; so that with either of those dia-

grams all three items can be given on the same sheet, one-half being assigned to the candle-power distribution curve and the other half to the flux. The chief value of the Pierce method resides in the enforced use of the lumen per unit area for illumination rather than some expression involving the conception of point light source. To the extent that it encourages the substitution of the term lumen per square foot for foot-candle, the method should be welcomed by illuminating engineers.

A Daring Scandinavian Transmission Project

In this issue are given some details of a bold and interesting project for long-distance international transmission of energy from Trollhättan, Sweden, to Copenhagen. The great Trollhättan plant, described in our columns Jan. 11, 1913, is itself a notable example of enterprise in the development of a great national resource. That some of the energy should be transmitted a distance of 200 miles is in itself nowise remarkable, but that the transmission line should extend far to the southward and under the strait into the ancient capital of Denmark lends something of startling novelty even to a project involving no sensational distance. Still more remarkable, from the standpoint of American conservatism, is the report of the engineers to whom the investigation of the project was intrusted by the Swedish government. After deliberate investigation of all the circumstances and the probable costs of carrying out the generation and transmission of some 20,000 kw to Copenhagen, the engineering commission found in favor of the Thury direct-current system as against the ordinary three-phase system. It is especially worthy of note also that the decision was not only in favor of direct current but also of the transmission thereof with a ground return.

We have had occasion several times to comment on the Thury system and also on that remarkable set of experiments which was tried to determine the efficacy of ground return, looking forward to just such a case as the one that has arisen now. We have consistently taken the attitude that while direct-current transmission has never appealed to American engineers, it is nevertheless neither dead nor sleeping, but very much alive, and the present situation well bears out this judgment. It is perfectly well understood that direct-current high-voltage transmission by constant current is a method of special rather than general applicability, and consequently it is not surprising to find that the conditions in the case here under discussion were somewhat exceptional, in a way that gave a fair chance for the employment of direct current.

The comparison was made on the basis of transmitting about 20,000 kw at fairly steady load into Copenhagen, and the comparison of costs was made between three-phase transmission of the usual sort at 100,000 volts and the Thury system at 90,000 volts. The advantage of the latter lies in the relative simplicity of the insulation problem, a thing which comes into play only at the extremely high voltages necessary for the economical transport of energy over very long distances. A large and steady load is also a favoring condition of no small importance. The matter of insulation, however, proved the determining factor in the case, and its importance was emphasized by the situation which arises near the receiving end of the line. The Strait of Öresund lies between Helsingborg, the southern terminus of the proposed land line, and the island of Zealand, on which Copenhagen is situated. To cross this strait, nearly 3½ miles wide, by cables carrying alternating current at 100,000 volts was adjudged an utterly impracticable proposition. It therefore became necessary to plan for a reducing station at Helsingborg, bringing the pressure down to 20,000 volts for transmission under the strait, beyond which it could either continue the relatively short distance to Copenhagen at 20,000 volts, or the electromotive force could be stepped up again if desirable. On the other hand, submarine cable can actually be obtained for 90,000 volts direct current, according to the report of the Swedish engineers, and consequently the energy could be carried through to Copenhagen without any reduction in voltage on account of the submarine work. This matter alone put the alternating-current project at a serious disadvantage, rendered even more formidable by the facility with which a grounded line can be used in operating at constant current. When the project was worked out in its details the alternating-current plan had little to recommend it save its orthodoxy, and orthodoxy does not necessarily help to pay dividends.

The comparison between the various items of expense in the two plans is a very instructive one. In the generating station the three-phase equipment had the advantage in first cost, as might have been expected, to the extent of nearly 30 per cent, owing to the necessity of using more units and more expensive units with the direct-current scheme. Two three-phase units were sufficient for the alternating-current plan, while the Thury system required twenty generators in four groups, each coupled to a 5000-hp turbine. In the line structure the tables are completely turned, the cost of the direct-current line being only about half that of the alternating-current line, not even taking into the account the difference in the cost of the cables and the presence of at least one extra transformer station in the alternating-current project. The cables for the three-phase transmission cost two and one-half times as much as did the direct current. The grand total for the alternating-current project reached $1,593,000, as against $1,202,000 for the direct-current project advised. When everything was footed up for the rival projects the estimated annual expense for the direct-current transmission was $6.75 per kw, as against $12.43 per kw for the three-phase project, to say nothing of the fact that the multiple transformations necessary with the latter would cause it to operate at a lower efficiency, thus yielding a materially small amount of power for the final distribution. All this is striking evidence of the great usefulness of direct-current transmission under conditions which are favorable to its economical use. No engineer would take the ground that such conditions always exist, even in that region of extremely high voltages in which direct current is known to have marked advantages as regards insulation. Beyond any doubt, however, high-voltage transmission at constant current is very far from being a dead issue, and it is not at all out of competition when high-voltage projects are to be considered.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Transpacific Wireless Stations

The Marconi Wireless Telegraph Company has placed contracts with the J. G. White Engineering Corporation, New York, for the erection of eight wireless telegraph stations, two pairs for Atlantic service and two pairs for Pacific service. Receiving and sending stations 30 miles apart will be constructed at Oahu, in the Sandwich Islands; Tamales Bay and Bolinas, Cal.; near Belmar, N. J., and in eastern Massachusetts at a point not yet definitely selected. These stations will be part of a globe-girdling system which will continue to the East by way of Japan and thence ultimately to India. Twelve towers ranging in height from 400 ft. to 450 ft. will be spread out over a semicircle covering a square mile at each station, and it is estimated that the range of each station will be from 4000 to 6000 miles.

Convention of Electric Vehicle Association to Be Held in Chicago

It is considered very probable that the next annual convention of the Electric Vehicle Association of America will be held in Chicago some time in October or November. Although definite arrangements have not yet been concluded, the advantages of Chicago as the next convention city have been so well and convincingly presented that the officers of the Electric Vehicle Association of America are strongly inclined to accept the proposition, seeing that the two previous conventions were held in New York and Boston respectively.

Movement for State Hydroelectric System in New York

Bills were introduced this week in the New York State Legislature authorizing the Conservation Commission to embark on a system of development and distribution of electricity from stored water along the line of the work of the Hydro-Electric Power Commission of Ontario. The bill will create a hydroelectric bureau in the commission, authorized to develop and distribute electrical energy at cost to municipalities. The commission is to have power of condemnation and may build storage dams, power plants and transmission lines. For this purpose the State is divided into development districts, and the bills create the first, or capital, district around Albany, to be served by the power company from the Crescent and Visscher's Ferry dam of the Barge Canal. It is provided that the initial cost, which it is estimated will not be more than $650,000 on plants to develop 12,000 hp, shall be paid by the State, and the cost of the energy developed to consumers shall be enough to pay the interest on this money and the upkeep of the plants and transmission lines and to wipe out the initial expense in fifty years. A system capable of developing and transmitting 12,000 hp will be first built, and this will later be enlarged to handle 35,000 hp. It is estimated that this development can be undertaken and an auxiliary steam plant installed to keep the output of electricity up to that standard, even in low-water periods, for about $1,500,000. The municipalities which it is expected will be served from the stations are located at distances ranging from 6 to 13 miles. These municipalities will have to build their own distribution systems, the State bringing its transmission lines only to the city limits.

Supreme Court Decision on Co-operative Manufacturing

On Feb. 3 the United States Supreme Court handed down a decision in the United Shoe Machinery case which has an important bearing on the interpretation of the Sherman law. The case came up on a writ of error to determine whether two counts in the indictment as construed by the District Court should stand. The District Court in Massachusetts threw out these two counts, and this action the Supreme Court upheld.

Up to Feb. 7, 1899, three separate concerns made most of the shoe machinery in use, but on that date they combined. These concerns, however, did not make the same kind of machinery, but each one made machines for doing some particular part of the work. Since the date of consolidation they have ceased to sell their machines, but instead lease them under the patent rights and require the lessees to use no other machines but theirs.

The District Court construed the indictment of the merger company—the United Shoe Machinery Company—as confined to the combination of Feb. 7, without regard to the subsequent leases or acts of the company. Thus the question reviewed by the Supreme Court was very limited. The act of combining companies which contributed the separate parts going to make a finished product was held to be entirely proper. In other words, it is not so much the size of the combination as its purpose or intent that constitutes an infringement of the law. The court said, in part:

"The disintegration aimed at by the statute does not extend to reducing all manufacturers to isolated communities of the lowest degree. It is as lawful for one corporation to make every part of a steam engine and put the machine together as it would be for one to make the boilers and another to make the wheels. Until the intent is nearer accomplishment than it is by such juxtaposition alone, no intent could raise the conduct to the dignity of an attempt."

The subsequent leases and the so-called "tying clauses," which are alleged to be legal under the patent laws, were not at issue in the present case. Judgment of the lower court was affirmed.

Preparations for Chicago N. E. L. A. Convention

As a very large attendance is expected at the annual convention of the National Electric Light Association to be held at the Medinah Temple, Chicago, during the first week in June, the preparations for this event are already well under way. It will not be surprising if the registration at Chicago reaches 7000 or more. A considerable proportion of this number will consist of members and visitors from Chicago and vicinity, and it is not unlikely that an arrangement will be made whereby the registration of the convention attendants representing the Commonwealth Edison Company will be made separately from the registration of the out-of-town delegates. This arrangement, if carried out, will undoubtedly assist in the laborious and high-

pressure work of handling the large throngs that will be in attendance.

While no official announcement has been made as yet of the personnel of local committees, it is learned that Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, has accepted President Tait's invitation to be chairman of the entertainment committee for the Chicago convention. One of the first of the local committees to "get busy" will be the hotel committee, and it is understood that Mr. Peter Junkersfeld will act as chairman of this committee, with Mr. E. A. Edkins as secretary. Both of these gentlemen are connected with the Commonwealth Edison Company and can be addressed at 120 West Adams Street, Chicago.

A particular effort will be made to look after the visiting ladies, and it is probable that there will be a large committee of Chicago ladies whose duty it will be to see that all visitors of their own sex are greeted and cared for hospitably, so that the men may be left free to attend to the work of the association.

Arrangements have been completed with Singer, the New York decorator who has had charge of recent N. E. L. A. exhibit effects, to design and execute the decorations for the exhibition hall at Chicago. The manufacturers' displays this year will occupy the great banquet room on the lower floor of the Medinah Temple. By an ingenious use of mirrors and lattice-work surrounding the columns it has been found possible to overcome the effect of the rather low ceiling imposed by the construction of the building, while by employing booth partitions of limited height the vista of the entire room from any given point will not be interfered with.

At a meeting of the transportation committee of the National Electric Light Association held in New York on Jan. 30 preliminary plans for conveying delegates to the Chicago convention next June were discussed. It is the intention of the committee to try to arrange for one or more special trains to the convention from San Francisco and Pacific Coast points, to be known as the Golden Poppy Special No. 2. Mr. E. B. Strong, committeeman from San Francisco, said that the Electrical Development League of San Francisco is creating enthusiasm for such a special tour. Of course, special trains will be run, as heretofore, from New York and also from Southern points. After the convention many of the Pacific Coast delegates contemplate a journey to the Atlantic Coast, stopping at various electrical centers and returning by way of Yellowstone Park.

Banquet of Patent Law Association

The Patent Law Association held its annual banquet in Washington on Feb. 1, its members and guests listening to addresses by Commissioner of Patents Edward B. Moore, Representatives R. J. Bulkley and Martin A. Morrison, both members of the House patent committee; Mr. C. C. Linthicum, of Chicago; Justice Van Orsdel, of the Court of Appeals of the District of Columbia; Mr. J. E. Laskey, president of the Bar Association of the District of Columbia, and others. The Oldfield patent bill, the prospect of a new building for the Patent Office and other patent matters were discussed by the speakers. Commissioner of Patents Moore made the principal address, and he told his hearers that there was nothing so seriously the matter with the present patent system of the country as to justify its being made completely over, as he said the Oldfield bill would do, if passed. He declared himself for higher fees, for additional officials and for higher salaries.

Representative Bulkley gave as his opinion that the patent laws of the United States are not so much at fault as is the administration thereof. He would have the Patent Office raised to a state of efficiency where no grants would be made not based on real invention, and declared himself in favor of a new building, increase in personnel and salaries and increase in pension fees for the rehabilitation of the system.

Representative Morrison advocated a patent bureau independent of any department of the government.

Federal Regulation of Niagara Falls Approved

After wrangling for more than a year the House committee on foreign affairs reached a complete agreement this week on the measure to regulate the use of water for power purposes at Niagara Falls. The measure gives the Secretary of War authority to regulate the diversion of the water at Niagara Falls, but leaves to the New York Public Service Commission the right to control the rates for electricity generated therefrom. No change is made from the present provisions of the Burton act limiting the amount of water to be diverted from the American side of the Niagara River to 15,600 cu. ft. per second.

Edison Association to Convene at Cooperstown, N. Y

The Association of Edison Illuminating Companies has completed arrangements to hold its twenty-ninth annual convention at the Hotel Otesaga, Cooperstown, N. Y., during the week beginning Sept. 8. Cooperstown is one of the finest summer resorts in New York State, and may be reached over the lines of the Delaware & Hudson Railroad. The Hotel Otesaga is said to compare favorably with any hotel in the country, and the Country Club at Cooperstown, which possesses an excellent golf course, will also be available for some of the functions. Lake Otesaga, near by, affords facilities for excellent water sports. Work on the various committee reports to be presented at the convention is already under way.

Electric Vehicles in Fire-Department Service

About 100 members and guests of the Electric Motor Car Club of Boston and the New England Section of the Electric Vehicle Association of America attended a theater party on Jan. 28 at which the use of electrically operated apparatus in fire-department service was featured by cinematograph displays. The hit of the evening was the presentation of a moving-picture play in which a country boy joins a city fire department and has various adventures. These photographs were taken recently at Springfield, Mass., which is probably the largest user of electrically driven fire apparatus in the United States. Views of the parade of electric vehicles in Boston last Memorial Day, when over 225 machines were in line, were also shown.

Prior to the entertainment, which took place at Keith's Bijou Dream Theater, a dinner was held at the Hotel Georgian. In the course of a brief business meeting plans were outlined to combat proposed legislation limiting to 800 lb. the weight per inch of width of tires of motor vehicles running on highways. Both electric and gasoline truck interests planned to hold a meeting at the American House, Boston, Feb. 1, to prepare a formal protest against this bill.

Convention of the Electrical Contractors' Association of New Jersey

The annual convention of the Electrical Contractors' Association of New Jersey was held in Newark on Feb. 1. Twenty-two new firms were admitted to membership and the officers elected were as follows: President, Mr. Elmer P. Strang, Camden; vice-president, Mr. J. P. Toman, Trenton; secretary, Mr. Jewell Van Dyke, Asbury Park; treasurer, Mr. Paul H. Jaehnig, Newark; state directors, Messrs.

Carl F. Adam, Trenton; Samuel H. Smith, Trenton; John H. Blaskill, Merchantsville; R. P. Ward, Dover; F. R. Evenden, Newark, and the national director, Mr. Paul H. Jaehnig, Newark. Representatives of central-station companies, jobbers and manufacturers were present at the banquet given in the evening, and the speakers and their topics were as follows: Mr. Frank D. Pembleton, contract agent of the Public Service Electric Company, "How New Business Is Obtained by the Company and How Contractors Can Obtain New Business"; Mr. E. P. Strang, "The State Association"; Mr. P. M. Thorpe, formerly state director to the national association, "Co-operative Electrical Development Society"; Mr. Carl F. Adam, "Status of the Electrical Contractor as a Business Man"; Mr. F. W. Fullerton, "The Relation of the Electrical Jobber to the Contractor"; Mr. M. B. Gleason, "Underwriters' Rules and Their Application to Electrical Trades"; Mr. E. L. Bradbury, "Illumination with Holophane Glass as Used in the Electrical Business"; Mr. P. D. Davis, "Insurance Protection." The next meeting of the association will be held at Asbury Park in July.

Electrical Equipment for Navy Department

Details of the plans of the Navy Department for the coming fiscal year in regard to the purchase of electrical equipment and material have been brought out at various hearings held before the House committee on naval affairs, which is now framing the naval appropriation bill and which will report it to the House about Feb. 10. Rear Admiral H. I. Cone, chief of the Bureau of Steam Engineering, which has charge of electrical equipment installation in the navy, told the committee that it will be necessary during the coming year to replace the batteries in at least eight of the submarine torpedo boats of the navy, and he also went into various matters in connection with coast signal radio stations, radio installations on board ship, gyro compasses, search-lanterns, etc. The sum of $666,500 is asked for the purchase of radio-telegraphic apparatus for land and sea use. Special appropriation under the Bureau of Navigation has been made for purchase of gyro compasses for the battleship fleet, and it is estimated that there will be twenty of these installations. The latest practice on torpedo destroyers provides for larger search-lanterns than those at present on board of twenty-six of the older destroyers. This will necessitate the purchase of two larger search-lanterns for each destroyer, and also two larger generating sets, making fifty-two search-lanterns and fifty-two generating sets. The estimate for the above is $364,200. It will also be necessary to replace the batteries in at least eight submarine boats, which will entail an expenditure of $320,000. Admiral Cone is asking for the coming year the sum of $2,927,000 for electrical machinery and equipment for the navy.

Photography by Invisible Light

Photography by means of ultra-violet and infra-red light was the subject of a lecture by Dr. R. W. Wood, professor of experimental physics in Johns Hopkins University, Baltimore, Md., before the New York Electrical Society Jan. 30. The address, which was recently delivered before the Royal Institution of Great Britain, was illustrated by lantern slides showing landscapes, objects, etc., photographed by ultra-violet and by infra-red rays, together with views of the moon and the Orion nebula taken with ultra-violet light.

Dr. Wood remarked that the longest infra-red rays thus far measured (those of the quartz-tube lamp) have a wave-length of 0.3 mm, while the shortest electrical waves observed are 2 mm in length, indicating a very brief undiscovered gap between the two sets of phenomena. The lecturer also described his "resonance" mercury-vapor lamp, and showed ultra-violet photographs of the invisible electronic discharge which proceeds from the ordinary electric arc, although not detectible by the eye. A current of air diminishes the intensity of this discharge within its own range but does not affect the streamers beyond.

The ultra-violet photographs exhibited were most interesting in showing the diffusion of the ultra-violet in sunlight by the sky and the consequent absence of ultra-violet shadows even in full sunshine. Ordinary glass is practically opaque to light of this short wave-length, while the pigment, "Chinese white," appears black under its illumination. Dr. Wood's lunar photographs also show hitherto invisible patches of heterogeneous material near one of the moon's craters, indicating strongly the possibility of these being sulphur deposits and so contributing to the evidence of their volcanic origin. The infra-red landscape views were remarkable for their black skies and strong shadows and for the snowy whiteness with which the green foliage appears, owing to the deep-red component of its chlorophyl coloring matter.

Drs. Emil Heuel and Edward C. Titus presided and discussed the subject, and they were followed by Prof. Charles Baskerville and Mr. W. J. Hammer, who spoke briefly.

At the Feb. 20 meeting of the society Mr. E. E. Sperry will lecture on the application of the gyroscope to the flying machine, and Lieut. T. G. Ellyson, U. S. N., will describe "The Flying Boat."

Electrical Display at New Orleans Mardi Gras

Celebrating the return of King Momus, jovial sovereign of New Orleans' annual Mardi Gras celebration, more than 25,000 vari-colored incandescent lamps made brilliant the streets of the Louisiana city during carnival week, Jan. 30 to Feb. 4, while at least 25,000 other units were used in the numerous and elaborate displays on the fronts of local buildings. Canal Street, as usual, was the center of festivity and light. Both transverse and longitudinal streamers of lamps marked this superb, broad thorough-

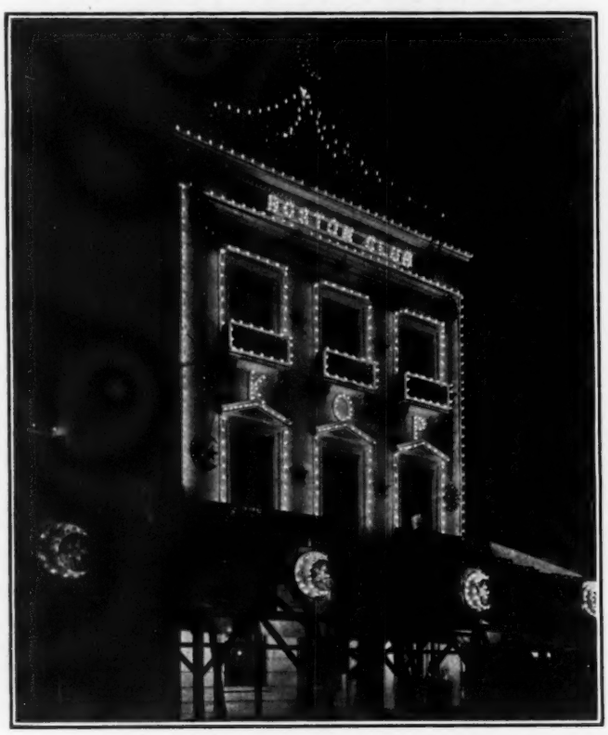


FIG. 1—MARDI GRAS ILLUMINATION OF BOSTON CLUB

fare. Festooned across the pavements and reaching to the middle "neutral ground" were hundreds of strings of purple, green and yellow lamps, the carnival colors.

The four clubs which foster the city's Mardi Gras spirit and celebrations had their own buildings handsomely decorated with electrical designs. The Louisiana Club was

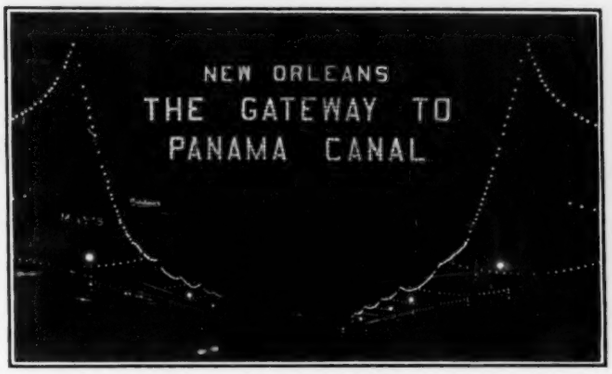


FIG. 2—WELCOME SIGN ON CANAL STREET, NEW ORLEANS

artistically outlined in lamps to simulate a Japanese temple, topped with a Japanese emblem. Banks of clear-globe tungsten lamps studded the façade of the Boston Club, setting off the galleries of fashionably attired people who watched the parade from this vantage point. Hundreds of lamps were used in decorating the Chess, Checkers and Whist Club, and the Pickwick Club's display included a great illuminated throne dedicated to the king of the carnival. Hotels and business houses also vied with one an-

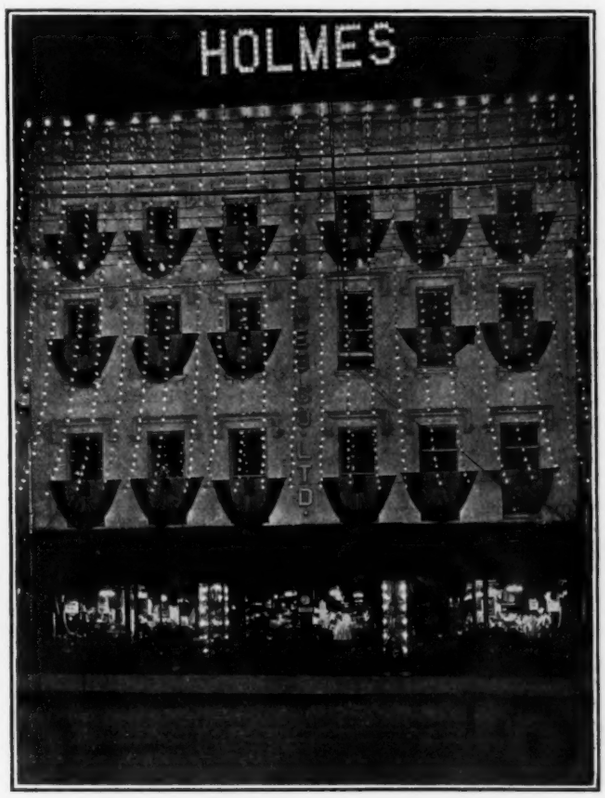


FIG. 3—MARDI GRAS DECORATIONS ON DEPARTMENT STORE

other in paying brilliant tribute to Momus. Among the most striking of the private electrical displays was that of the Holmes department store, illustrated herewith, where strings of lamps were festooned across the white front. The Elks' Club exhibited another handsome installation. The New Orleans Railway & Light Company also signalized the celebration by installing a mammoth roof sign on its new office building, which attracted much complimentary comment from the carnival crowds.

A feature of the Mardi Gras celebration on Saturday evening, Feb. 1, was a parade and pageant arranged by

FIG. 4—ELECTRIC STREAMER DECORATIONS, NEW ORLEANS

members of the Jovian Order from New Orleans and nearby Southern cities. A number of decorated floats and automobiles made up the procession, which followed the course taken by other night parades, ending at the Hotel Grunewald, where an initiation and banquet were held under the direction of Mr. Fred B. Stern, Louisiana statesman.

Special Illumination for Inauguration

Washington is planning a most elaborate illumination of the city streets and public buildings in honor of the inauguration of Wilson and Marshall on March 4. The dome of the Capitol is to be brilliantly illuminated from large searchlanterns placed on the west roof of the building and on the roofs of the House and Senate office buildings. There will be an added attraction in the "Court of Honor" to be constructed before the White House. This will be a reproduction of the classic part of the Jefferson mansion at Monticello, and on either side of it will be a stand designed for the seating of distinguished guests. The porch in which the President is to sit will have "spot" lamps directed against it so as to bring it out in bold relief. No lights are to be on the stand, but there is to be a hedge of cedar trees on either side of it, which are to be brilliantly illuminated with color boxes which will throw on this hedge of cedars a dense blue and gold light in sharp contrast with the green foliage. At the ends of the "Court of Honor" there will be a classic group of statuary placed in a recess formed by the trees extending to the curb line, and the back of this group will be illuminated from incandescent lamps concealed in the foliage, while the front will be brought out sharply by means of "spot" lamps. From 1200 to 1500 varicolored miniature lamps operated on flasher circuits will be irregularly placed in the hedge so as to obtain an effect similar to that given by fireflies.

Pennsylvania Avenue will be decorated from the Treasury to the Peace Monument with looped festoons supported at three points on steel messenger wires. From the center of the span there will be dropped a brilliantly illuminated pendant of light in varicolored lamps. These festoons will be placed at intervals of 100 ft. The fountain will be in operation at the Peace Monument, at the base of the Capitol, and this work of art will be brightly lighted from three "spot" lamps placed near the base. These lamps will be provided with color screens, so that combinations of color can be effectively used on the flowing water.

The Washington Monument will be illuminated by searchlanterns and "spot" lamps, the latter to be placed in the

monument lot with their rays directed toward the lower portion of the monument, while projectors from the Raleigh Hotel, from the State, War and Navy Building and from the Potomac Electric Power Company's building will be directed to the north and east sides of the shaft. Flagpoles located back of the Columbus Memorial at Union Station will be brilliantly spiraled with electric lamps, and "spot" lamps will be used to bring out the beauty of the memorial. Cedar trees, effectively decorated in the manner of a Christmas tree or with festoons of lamps suspended immediately over them from poles, will be used to outline the plaza at Union Station. In all of the festoon work for the inauguration decorative twin-conductor cables will be used and the lamps employed will be mainly of 4-cp rating with clear globes.

Contract Between Great Falls Power Company and Puget Sound Railway

In connection with the plans for the electrification of the Chicago, Milwaukee & Puget Sound Railway from Harlowton, Mont., to Avery, Idaho, the details of the contract between the railway company and the Great Falls Power Company, mentioned briefly in our issue of Jan. 11, are of some interest. This contract is made part of the articles of agreement between the power company and the federal government, by which a fifty-year grant of right-of-way for transmission lines across public lands was secured.

The railway company agrees to electrify its line between Harlowton and Deer Lodge, Mont., before Jan. 1, 1918, and also agrees to buy from the power company electric energy at the rate of 10,000 kw for the full period of the ninety-nine-year agreement, but two years' notice will be given the power company that delivery must commence. The railway company has several options for more power, up to a total rate of 25,000 kw, as follows: Not less than 4000 kw, nor more than 8000 kw, if called for prior to Jan. 1, 1923; not less than 3500 kw, nor more than 7000 kw, if called for between the last date and Jan. 1, 1928; or, failing to exercise the foregoing options, the full 25,000 kw may be called for at any time between Jan. 1, 1918, and Jan. 1, 1928, if at least 6300 kw additional has been called for prior to Jan. 1, 1923. Additional energy, when once called for, as above, will be supplied for the entire remaining term of the contract. The power company is not liable for interruptions to supply, nor the railway company for interruptions to its consumption, owing to causes beyond their control, such as strikes, fires or floods. The contract will be broken automatically in the event that the federal government permanently enjoins at any time from the enjoyment of its privileges. The railway company is made a preferential customer entitled to first service.

Delivery of energy will be made to not more than five stations between Deer Lodge and Harlowton, at 50,000 volts or 100,000 volts, three-phase, 60 cycles, alternating current. The voltage shall not be changed except by mutual agreement. The railway company will receive the energy at the terminals of air-break, high-tension line switches to be provided by the power company and will transform and distribute such energy to its line of railway in such manner as it sees fit. Watt-hour meters and curve-drawing wattmeters will be employed to measure the energy delivered. The railway substations are to contain sufficient synchronous machinery to secure a power-factor, leading or lagging, of at least 80 per cent. Twelve months' notice will be given the power company of the location of the delivery points. The power company will also have the right to install Tirrill regulators in the substations for the operation of synchronous machinery in such manner as to receive any power-factor between 80 per cent leading and 80 per cent lagging.

The rate for energy will be $0.00536 per kw-hr., subject to a minimum bill after the first year of service equivalent to 60 per cent of all the energy contracted for. The power company is also required to pay the federal government a tax of 5 mills per 1000 kw-hr. for all energy delivered over transmission lines crossing the public domain. Other details between the power company and the government were published in our issue of Jan. 11.

The power company also has the conditional right to occupy the railroad right-of-way with its transmission lines, subject to sixty days' notice of removal, and such transmission lines shall not interfere with the operation of the railway or its telephone or telegraph lines. The railway company is forbidden to resell any of the energy purchased of the power company. Disputes of any nature between the two companies will be referred to and settled by a board of three arbitrators, chosen one by each company and the third by these two.

Conference on Meters in Ohio

At a conference of meter men from the electric lighting companies of Northwestern Ohio, held at Lima, Ohio, on Jan. 17, the following subjects were presented for consideration and general discussion: (1) Advance in metering conditions to be brought about by co-operation of the various meter departments, by Messrs, A. H. Bryant, of Cleveland, and R. S. Graves, of Cincinnati. (2) Importance of maintaining meters within commercial accuracy, by Mr. F. C. Jennot, of Marysville. (3) Essentials in meter testing, by Mr. C. B. Stelle, of Springfield. (4) The office and record side of meter testing, by Mr. John Himes, of Dayton. The meeting, one of the first of its kind ever held in Ohio, was a source of encouragement to the meter committee of the Ohio Electric Light Association, which is trying to bring about a co-operation among the electric-lighting companies of Ohio so as to obtain a more efficient metering system.

Opposition of Wood Preservers to Duty on Creosote

At the ninth annual meeting of the American Wood Preservers' Association, held in Chicago on Jan. 21, 22 and 23, there was an attendance of about 200, including many representatives of railroad and commercial wood-treating plants. In his address President E. A. Sterling, of Philadelphia, remarked that the membership of the association had increased from 104 to 157 during the last year and that it was doing a constantly increasing amount of useful work. The association aims to standardize wood-treating processes. Mr. Sterling referred to the decided advance in the price of creosote during the year and to the additional menace pending because of the proposed 10 per cent duty on imports of creosote. He recommended various subjects of investigation by committees and urged that the association give greater publicity to its work.

The secretary-treasurer's report, submitted by Mr. F. J. Angier, of Baltimore, showed the finances of the association to be in a satisfactory condition. Twenty-nine railroad companies are represented in the association and a considerably larger number of commercial wood-treating plants. The wood-preserving industry is perhaps on a better basis than ever before. The secretary also read a letter recently written by President Sterling to Mr. O. W. Underwood, chairman of the ways and means committee of the House of Representatives, in which, speaking for the American Wood Preservers' Association, the writer asked that coal-tar creosote be retained on the free list of the tariff. Mr. Sterling explained that only about 30 per cent of the creosote used in this country is produced in the United States. There is an actual shortage in the European market and prices have increased sharply in the last few years, promising to go still higher. Mr. Sterling

pointed out the importance of the subject of wood preservation in relation to the conservation of the timber resources of the country.

Mr. B. A. Johnson, publisher of the *Lumber World Review*, of Chicago, made an address of welcome, in which he embodied a plea that greater and more intelligent publicity be given to the practical working of wood preservers. Mr. J. H. Waterman, of Galesburg, Ill., responded for the association.

A number of papers were presented relating in general to either the technical side of the art of wood preservation or the practical applications in plants for treating railroad ties or wood paving block. There was little or no reference to the treatment of poles or cross-arms. One point brought out by a visitor was that in applying preservative to wood the factor of heat is nearly as important as that of pressure.

Following the recommendation of President Sterling, the association adopted a strong set of resolutions in opposition to the proposed levying of an import duty on dead oil of coal tar, or creosote. These resolutions point out that it is necessary to import large quantities of creosote, the domestic supply being entirely insufficient to meet the demand. In 1912 about 60,000,000 gal. was imported. Practically all of this amount was used in the preservation of timber, serving to increase from three to five times the life of wood used in the industries. Thus the use of creosote is of the greatest importance in the preservation of the timber resources of the country. The proposed duty of 10 per cent would interfere very seriously with the art of wood preservation, and the association urges that Congress retain creosote on the free list, as at present.

Entire unanimity was exhibited in discussion of this subject, which the association considers of vital importance. It was voted to send copies of the resolution to all members of the Senate and House of Representatives, and the association also urged upon all members to use their personal influence with members of Congress to prevent imposition of the proposed duty. A committee was appointed to wait on the ways and means committee of the House of Representatives and present the arguments of the association. This committee consists of Mr. E. A. Sterling, of Philadelphia; Dr. Herman von Schrenk, of St. Louis; Mr. William A. Fisher, of Gainesville, Fla.; Mr. George A. Lembcke, of New York, and Mr. Earl Stimson, of Baltimore.

A resolution was also adopted approving the existing plan of maintaining national forest reserves by the federal government and opposing the movement to turn these forest reserves over to the several states.

Another resolution expressed the sense of the association that unsound timber should not be treated and that treating plants should not allow customers to persuade them to attempt wood preservation when the conditions are such that the proposed preservation is of no real benefit.

The thanks of the association were expressed to Messrs. H. F. Weiss, F. M. Bond and C. P. Winslow, of the Forest Products Laboratory of the government Forest Service at Madison, Wis., for presenting papers before the association.

In relation to standard specifications for the testing of creosote a committee, of which Mr. H. M. Newton, of Minneapolis, was chairman, made a progress report. It was recited that further work should be done before standard specifications could be recommended, and it was noted that 80 per cent of the members who had replied to an inquiry favored the retort method of testing. The standards of the National Electric Light Association and of the Forest Service were mentioned by the committee. Mr. Weiss said that he could not approve of the retort method of testing creosote oil.

Mr. H. F. Weiss, director of the Forest Products Laboratory at Madison, Wis., and Mr. C. W. Berry, of Laramie, Wyo., were elected honorary members of the association.

Officers for the ensuing year were elected as follows: President, Mr. A. E. Larkin, Minneapolis; first vice-president, Mr. J. H. Waterman, Galesburg, Ill.; second vice-president, Mr. E. B. Fulks, Chicago; third vice-president, Mr. George E. Rex, Topeka, Kan.; secretary-treasurer, Mr. F. J. Angier, Baltimore. After a spirited contest New Orleans was selected as the place of the 1914 meeting.

Tariff Hearings

Extended testimony of much interest was given before the ways and means committee of the House of Representatives on the subject of incandescent lamps, following the brief submitted on rods and wire, of which we presented an abstract last week.

INCANDESCENT LAMPS

Mr. B. A. Levett addressed the committee on behalf of the Lamont-Corliss Company in reference to incandescent lamps. His company is an importer of such lamps from Europe. He asked for a reduction in the present duty of 45 per cent under the basket clause to 10 per cent ad valorem. The witness then quoted the following from the government's bill of complaint in a suit against the General Electric Company:

"Approximately 80,000,000 incandescent electric lamps are manufactured, sold and used annually in the United States, of an aggregate value of about $18,000,000. Of these, the defendants, in virtue of their combination and conspiracy hereinafter described, control the manufacture and sale of more than 97 per cent."

He next asserted that the General Electric Company controls 97 per cent of the incandescent lamp business in this country. The Lamont Corliss Company started to import foreign lamps in 1909, when tungsten filaments were being produced by the squirting process, instead of being wire-drawn, as at present. The prices of tungsten lamps at that time were as shown in the accompanying table. When

TUNGSTEN LAMPS—PRICES, COST AND PROFITS

Size of Lamp	PROGRESSIVE REDUCTIONS IN PRICES					Cost of Manufacturing	Net Price	Per Cent Profit
	1	2	3	4	5	6	7	8
25-watt.....	$0.85	$0.70	$0.65	$0.50	$0.40	$0.107	$0.280	161.
40-watt.....	1.00	0.80	0.70	0.55	0.45	0.110	0.315	186.
60-watt.....	1.40	1.10	1.00	0.75	0.60	0.167	0.420	151.
100-watt.....	1.74	1.45	1.35	1.10	0.90	0.217	0.630	191.

the prices were those shown in the first column the importers were obtaining the so-called Kuzel lamp, but the General Electric Company, he said, secured control of it. Then the importers secured a brand of lamp made in Holland and thereupon the General Electric Company cut its prices to those shown in the second column. The importers followed suit, said Mr. Levett, and the former company made another cut to the prices given in the third column.

Then, in the effort to produce a less fragile lamp, the wire-drawn filament was introduced and the foreign manufacturers soon duplicated the performance. This precipitated another price cut to the figures in the fourth column. On Oct. 1, 1912, the prices were cut still more, as given in the fifth column. The sixth column shows what, the witness declared, was the actual cost of production to the General Electric Company. The seventh column shows the net price after discounts ranging from 17 to 37 per cent on the average, and the eighth column the per cent of profit. Mr. Levett said his figures came from a confidential but reliable source, and that the cost may be even less than that given. Foreign-made lamps sell at about 10 cents each on the other side. He also declared that the General

Electric Company, because of the high tariff, is driving the importers out of business.

An extended brief was also filed by the Laco Phillips Company, of New York, importer. The lamp business is now and has been for twenty years past controlled by the General Electric Company, said the statement. The prices given in the table were confirmed as of the following dates: Column 1, 1909; column 2, Feb. 1, 1910; column 3, April 1, 1911; column 4, March 1, 1912; column 5, Oct. 1, 1912. The cost of production for various sizes of lamps was stated, agreeing with column 6 in the table, while 150-watt lamps are said to cost about $0.341 each and 250-watt lamps about $0.50. The General Electric Company was declared to be quoting its sub-factories to-day at discounts of 50 per cent, 10 per cent, 10 per cent and 5 per cent from the list, bringing the net figures to the following: 25-watt, 15.39 cents; 40-watt, 17.31 cents; 60-watt, 23.08 cents; 100-watt, 34.63 cents.

The output of the largest manufacturer abroad who ships to this country does not exceed, said the brief, 1,250,000 lamps a year. But 20 per cent of the cost of manufacture is labor. The figures in columns 6, 7 and 8 of the table were confirmed also. A reduction of the duty to 10 per cent was asked for in order to permit competition from foreign lamps and save the situation for the importers.

Western Association of Electrical Inspectors at St. Louis

The eighth annual convention of the Western Association of Electrical Inspectors was held at the Planters' Hotel, St. Louis, Mo., Jan. 28, 29 and 30, the opening session, as reported by telegraph in these columns last week, being attended by more than seventy delegates.

Following the address of welcome by Mayor F. H. Kreisman of St. Louis and the response by Mr. B. W. Clark, of Detroit, Mich., Mr. W. J. Canada, engineer for the Rocky Mountain Fire Underwriters' Association, Denver, Col., president of the inspectors' association, delivered his annual address. In this he emphasized recent rapid advances to the present uniformity of electrical inspection methods, a uniformity which, he declared, is unusual in the application of any other construction standard. For eight years the work of the Western association has been directed toward securing this desirable uniformity. Increasing demands on the inspectors have made them necessarily greater factors in their communities. President Canada urged further restrictions in the use of flexible cord and the connection of electrical appliances to final circuits as being among the more pressing inspection problems demanding early consideration from the association.

The report of Secretary-treasurer W. S. Boyd, Chicago, showed the association's present membership to number 172, with a geographical range from Seattle to Montreal and from Winnipeg to Texas.

Electrical Porcelain

In his paper on the subject of electrical porcelain Mr. F. A. Driscoll, of Pass & Seymour, Chicago, traced the history of white-clay working in China and at Dresden, Germany, and the use of white kaolin, feldspar and quartz mixtures. After describing the processes of grinding, mixing, glazing with non-metallic flux, firing, sizing, etc., the speaker referred to the cost of the dies necessary for forming such complicated pieces as transformer cut-outs, which sometimes runs into thousands of dollars. An interval of about one week is ordinarily required to convert the raw material into the finished porcelain product. Messrs. H. H. Bloomer, Milwaukee; B. H. Glover, Chicago, and W. J. Canada, Denver, took part in the discussion, in which the desirable quality of toughness in electrical porcelain was especially emphasized.

High-Voltage Line Requirements

Mr. H. B. Gear, Commonwealth Edison Company, Chicago, followed with a paper on "High-Voltage Transmission-Line Requirements." For moderately high voltages the speaker indorsed underground construction on account of its assurance of service continuity. Intersecting railroads and telegraph and telephone lines impose many and varying restrictions on overhead construction. Cradle crossings have in many cases caused more troubles than they were expected to save. Attempts are now being made to draft uniform crossing specifications, including such vital requirements as short spans, 30-ft. minimum clearance above tracks, minimum wire size No. 4 copper or No. 1 aluminum, high safety factor with allowance for simultaneous sleet and wind, ground-stripped cross-arms, and straight-line construction near crossings. Instances of the antagonism existing between telephone and transmission interests were cited; this often results in enjoining power circuits from paralleling established signaling lines.

In answer to a question by Mr. G. W. See, Minneapolis, Minn., Mr. Gear said that 13,000-volt cable would be preferable to open-wire construction where continuity could be assured, although if many cables were to be installed underground construction might prove equally cheap and to be preferable. Mr. Gear insisted that weatherproof braids protect linemen up to 2300-volt pressures if joints are well taped, although beyond this voltage the protection is chiefly psychological. In the discussion the point was developed that mechanical wire-break devices, like the Dostal drop-out, have in many localities established an unassailable reputation for reliability.

Laboratory Test Problems

"Electrical Laboratory Test Problems" was the title of a paper by Mr. B. H. Glover, associate electrical engineer of the Underwriters' Laboratories, Chicago, in which the author described the relation between field inspectors and laboratory workers in the protection of life and property. Mr. Glover also emphasized the need of tabulated experience taken from the field, citing such examples as defective contacts in ground clamps, design of cut-out and automatic-switch cabinets, etc. The discussion which followed brought out several minor inconsistencies in code requirements.

The 660-Watt Branch Circuit

The letter on the subject of the 660-watt branch-circuit limitation received from Mr. W. H. Blood, Jr., Boston, Mass., insurance expert for the N. E. L. A., as mentioned last week, occasioned lively discussion. Mr. Blood's views are given fully on another page of this issue. The author's suggestion that No. 12 be used for final circuits instead of No. 14 was objected to on account of its greater cost. Some approval was accorded to the proposal to abolish the 10-amp fuse, but on condition that No. 18 wire be prohibited for either flexible cord or fixture wire. The present requirements of 660-watt final circuits and the twelve-socket limit were strongly defended. Mr. Canada pointed out that any relaxation of the present rules might tend to still greater increases of future limitations. Mr. Glover reported that a 250-volt, 660-watt socket is now being marketed. The sense of the meeting apparently favored restricting sockets to such capacities if the 6-amp limit is to be raised.

Status of Grounded Secondaries

An extended paper, "The Present Status of Grounded Secondaries," was next presented by President Canada, electrical engineer Rocky Mountain Fire Underwriters' Association, Denver, Col. This valuable treatise included a collection of data on injuries and accidents resulting from contacts with transformer secondaries and a compilation of grounding-practice data obtained from 100 representative operating companies in the United States and Canada. The latter information is given in detail on another page of this issue. Besides tracing the history of grounding, the author

entered into a discussion of its chief theoretical considerations. Then followed a careful exposition of the practical advantages and disadvantages of grounding, use of interconnected secondaries, use of and opposition to water-main grounds, cost of grounding, effect on meters and transformers, electrolysis of service connections, relation of conduit grounding, etc.

In conclusion Mr. Canada declared unshaken the evidence that: (1) Properly grounded secondaries are a thorough safeguard against entrance of high voltages from every source on building wiring. (2) Prevention of high voltage in building wiring prevents personal injury, fire, meter troubles, lamp burnouts, and usually transformer breakdowns. (3) Grounding is effective in proportion to its thoroughness. (4) Grounding introduces no known troubles not already existing either in life hazard, fire hazard, prejudice to building piping systems or operating difficulties, and increases none. (5) Thorough grounding entails numerous grounds, good grounds, easily inspected grounds, and grounds close to buildings to be protected. (6) Grounding emphasizes the value of solid neutrals in interior conduit wiring. (7) Grounding should not be prohibited by code rule because of very slight current flow through ground connections. (8) Grounding is equally desirable as protection against undesigned voltages on secondaries of all voltages.

After some discussion Mr. Canada's paper was referred to the code committee, and a vote of thanks extended to the author for his work.

Reports on Stage and Display Lighting

An interesting portion of the convention program was the reading of committee reports, which occupied a full day.

A rule advocated by the committee on theater wiring, prohibiting link fuses on stage switchboards, was supported in discussion by Messrs. Waldenfels, F. Daniels, R. Daniels and J. Hall, the last-named directing attention to the panic possibilities of open fuses. Requirement of insulators in each "border-light" support cable was also indorsed, and the adoption of uniformly interchangeable plugs and pockets for stage work was urged.

The committee report on show-window and display lighting, presented by Mr. F. P. McGough, Omaha, Neb., chairman, secured the convention's indorsement of flush-type waterproof receptacles as the only acceptable fitting for show-window floors and of the prohibition of key sockets.

The convention also indorsed the recommendation of Mr. F. J. Burch, Chicago, chairman of the committee on induction motors, that a table of sizes for motor leads and branch and running fuses be specified for the National Electrical Code. Inspectors do not find the code's provisions to prevent over-fusing generally complied with, it was shown. Several manufacturers present offered their co-operation and help in formulating such a table.

Ordinances and Public Safety

Through its chairman, Mr. W. S. Boyd, Chicago, the committee on laws and ordinances recommended requirements for porcelain sockets near grounded surfaces. Discussion showed that much dissatisfaction has resulted with the life of reinforced portable cord in garage service, although the impracticability ascribed by garage men to the vapor-proof lamp is largely an indication of their general disregard for restrictions of any nature, an attitude accounting for much of the high fire hazard in such buildings. The discussion turned upon comparative values of galvanized and enameled conduit under action of acid and concrete. Among those who took part were Messrs. Waldenfels, McDowell, Fred Adams and other manufacturers' representatives, opinion apparently favoring galvanized fittings, if available.

The report of the committee on public safety was divided by the chairman, Mr. W. J. Canada, Denver, into two parts, the first offering general recommendations and the second suggesting definite changes in present code rules governing grounding of secondaries. The following general changes from present practices received the association's indorsement and were by it referred to its code committee with instructions to recommend them to the electrical committee of the National Fire Protection Association: (1) Elimination of flexible cord where practicable, and particularly in certain hazardous plans, such as warehouses, flour mills, kitchens, bakeries, meat shops, stables, etc. (2) Prohibition of brass-shell sockets and fixtures in kitchens, bakeries, meat shops, stables, etc. (3) Prohibition of open contacts in wiring installations, particularly by use of cabinets, knife-switch inclosures, etc. (4) Requirement of conduit in all places where by any possibility open wiring can become mechanically disturbed or its insulation injured so that personal contact or fire may result. (5) Protection, by effective grounding, of all circuits in buildings, or where subject to handling by the public or by employees in industrial establishments, from abnormal voltages of all sources. (6) Grounding of casings of all motors, generators, oil switches, cabinets, etc., where surrounding grounded surfaces exist.

The following changes in the present code rules on the grounding of secondaries were also indorsed and after full discussion were recommended for transmission to the electrical committee of the National Fire Protection Association: (1) Station ground connection to all available water-pipe systems and to any available permanently moist earth. (2) Similar ground-connection requirements for transformer banks. (3) Overhead-line neutral or grounded sides must be grounded every 500 ft. as above, or, if underground, grounded at every subway box. (4) Individual services should be grounded to water pipes, outside meters, fittings, etc. (5) Station ground-wire should be as large as the largest wire of the system and be carried in a straight line to the ground. (6) Ground wire at transformer bank should be as large as the wire grounded; never less than No. 6. (7) Individual service ground connection to be not smaller than No. 6 and at least half of the size of the largest secondary wire. (8) Ground wire should be run outside the building and protected within 7 ft. of the ground by conduit. Conduit may be used if necessary to run the ground wire inside of the building. Well-bonded conduits are permissible as part of the ground connection.

Discussion of Code Revisions

As the Western Association's convention closely preceded the biennial issue of the National Electrical Code, a special study had been arranged of various code sections at the suggestion of President Canada, assignments being given to committees. Discussion of general inspection problems and experience with present code requirements occupied one session. Motor drive for motion-picture machines was welcomed if approved arrangements are provided. Much trouble with porcelain-tube services has been experienced, and conduit services were favored. It seemed to be the general practice to require no additional heat protection where oil-immersed auto-transformer starters are installed on frame partitions. Re-inspections were believed generally to be insufficient and poorly handled, largely from lack of funds, although some portions of Quebec and Ohio constitute happy exceptions to this statement and Chicago and Detroit report fair results.

Several manufacturers spoke briefly concerning their wish for co-operation with inspection departments and commended the highly desirable uniformity to which the Western Association of Electrical Inspectors is largely contributing. The protection afforded by thorough inspection against the use of inferior products was declared to have figured largely in the rapid advance of safety in electrical materials.

At the request of Mr. Atwood, of the National Metal Molding Company, the position of the association was expressed by vote as indorsing single braid for rubber-covered wire in metal molding. The convention indorsed the use of such molding run without additional protection through partitions but discouraged the use of more than 660 watts per two-wire or three-wire circuit in any metal molding. The association further resolved to support the prohibition of wood molding in all locations.

Election of Officers

The nominating committee, through Chairman Waldemar Michaelsen, Omaha, Neb., recommended the following officers, who were formally elected to serve the association for the ensuing year. President, Mr. James Bennett, assistant manager Canadian Fire Underwriters' Association, Montreal, Canada; first vice-president, Mr. B. W. Clark, city electrician, Detroit, Mich.; second vice-president, Mr. A. W. Davis, city electrician, Spokane, Wash.; executive committee, Messrs. H. M. Maxwell (chairman), G. W. Lee, W. J. Canada, S. J. Conrad, H. M. Davis and W. B. Hubbell.

Entertainment

The entertainment features of the program were arranged by Mr. J. H. Fenton, chief electrical inspector of the Missouri Inspection Bureau. On Tuesday evening, Jan. 28, the inspectors were the guests of the St. Louis League of Electrical Interests, Jovian Chapter, at its annual banquet at the Mercantile Club. Secretary W. S. Boyd, Chicago, replied to the welcome of President A. C. Einstein, general manager of the Union Electric Light & Power Company, and the evening concluded with a number of entertainment features of unusual interest. On Wednesday evening the Jovian Order held a rejuvenation at the Elks' Club, when more than 200 attended and a class of eighty-two was initiated. The degree team comprised Messrs. L. S. Hunt, W. E. Rapp, J. P. Casey, W. N. Matthews, Charles A. Dostal, J. H. Fenton, F. D. Phillips, R. H. Robinson, P. V. Brokaw, S. N. Clarkson, R. W. Stockwell, W. F. Barklage and D. Houck. Mr. S. A. Hobson, Western manager of the *Electrical World*, spoke of the high personnel of the night's initiates and gave a résumé of the order's history. Talks on Jovianism and co-operation were also given by Mr. W. N. Matthews, St. Louis, and others.

Mr. McHenry on Railroad Electrification

In response to a recent request of the Boston banking house of Thompson, Towle & Company for a statement regarding electrification plans on the New York, New Haven & Hartford Railroad, Vice-president E. H. McHenry has issued a statement pointing out that the New Haven company is now committed to an expenditure of $20,000,000, covering work along this line completed, in progress or authorized. In addition to the work between Woodlawn and Stamford, completed several years ago, the company has substantially finished the work on the Harlem River and Westchester lines. Construction is actively in progress between Glenbrook and New Haven, and the electrification of the main line between Boston and Providence will begin in the spring. The latter is the first step toward the ultimate electrification of all the steam railroad lines within the suburban radius of Boston. Mr. McHenry states that in his opinion electricity will be installed upon a large scale within the next decade, particularly at the great railroad centers. He believes that the initial electrification of congested traffic centers will be followed by an ever-extending zone of electrical operation until such centers are finally interconnected by electrically operated lines. In the larger cities the obligations to electrify will be forced upon the companies regardless of economy and considerations of uniformity, and disabilities attending a break in the kind of operation will make it economical and desirable to extend the electrification to parts of the railroad system which would not be justified if independently considered. Mr. McHenry says that as yet little direct economy has resulted from the electrification already completed but that "the indirect advantages are large, and with an extension of electric operation to include passenger, freight and switching service, it is probable that a direct and sufficient return upon the necessary investment will be secured under favorable conditions. . . . In general it may be stated that the principal and almost the entire economy to be effected by electric operation is comprised in the two items of fuel and engine repairs, which will be approximately reduced by 50 per cent."

Governor Dunne Favors Municipal Ownership

Mr. Edward F. Dunne, who was inaugurated Governor of Illinois on Feb. 3, has apparently lost none of the zeal for municipal ownership which was such a prominent characteristic of his administration as Mayor of Chicago several years ago. In his inaugural address as Governor he declared that the day of competition in the supply of gas, electric service, street-railway service and some other public utilities has passed. Only one utility of each description should be allowed the privilege of doing business in each city. "The sole aim of all private corporations unregulated by law," said the Governor, "is to make money for their stockholders, and the most money can be made by poor service at a high rate to the consumer." After this rather startling statement Governor Dunne stated his position in the following paragraph:

"While most cities of Illinois may not be ready as yet to undertake municipal operation of other than waterworks, legislation should be enacted immediately giving all cities the right to build or buy and to operate their utilities. For this purpose cities should be empowered to issue bonds, subject to a referendum and such other reasonable safeguards as may be necessary. If such rights are given, it will force private corporations now furnishing these utilities to give decent service at decent rates or face the alternative of public ownership."

The Governor favors municipal control of purely local utilities, but says that what might be called "interurban utilities," including electric railways, natural-gas supply, electric transmission and telephone service, can be regulated only by the State. For that purpose he recommends the creation of a state public utility commission with large powers. This commission should control the issue of securities, the character of service, the rates to be charged, etc. The control of city utilities might be given to the commission on the request of the municipality concerned. However, it should be empowered to secure uniformity of accounting and full publicity with respect to both municipal and "interurban" utilities.

In relation to the issuing of securities by public utilities, the state commission should have full control. On this point the Governor says:

"It should be distinctly provided that future issues of securities, when approved by the commission, should be clearly separated by serial numbers, or otherwise, from existing securities, to the end that purchasers might always know whether they were buying new securities approved by the State, and issued for an increase of physical investment, or whether they were buying securities issued prior to the enactment of the law and that had not in any way passed under the scrutiny of the State."

Another of the Governor's recommendations is that Chicago shall receive the right, "enjoyed" (as he says) by the city of St. Louis, of creating a public utility commission which shall report directly to the City Council and possess such powers and resources as may be conferred upon it by the city itself.

Public Service Commission News

MASSACHUSETTS COMMISSION

Following the recent order of the Gas and Electric Light Commission reducing the price of gas from 85 to 80 cents per 1000 cu. ft. in the city of Haverhill, the Haverhill Gas Light Company, one of the Stone & Webster properties, has brought suit in equity in the United States District Court against the board and Attorney-General Swift, raising the constitutional question as to the right of the defendants to compel the plaintiff company to reduce the price as ordered. The company contends that the manufacturing conditions under which it operates should cause the price to be not less than 95 cents. An injunction is sought against the enforcement of the order.

WISCONSIN COMMISSION

The Wisconsin Railroad Commission has taken testimony on the application of the city of Milwaukee for an order reducing the rates of the Milwaukee Gas Light Company. The present value of the property, according to the appraisal of the commission, is $8,770,000. The value of the physical property was accepted by both parties and the testimony confined to the question of overhead expenses and going value. The company, through its experts, endeavored to show that the commission's allowance of 15 per cent for overhead expenses was too low. The various experts testified that in their experience an allowance of at least 30 per cent was a conservative estimate, and one considered that 36.5 per cent was none too high for the property in question. He apportioned the items as follows: Contractors' services and expenses, 10 per cent; cost and maintenance of works office, 3 per cent; insurance and damages, 1 per cent; taxes, 2 per cent; organization and legal expenses, 5 per cent; interest during construction, 7.5 per cent; expenses of placing securities, etc., 5 per cent. Considerable testimony was offered to substantiate the company's claim of approximately $2,500,000 of going value. Evidence offered by the defendant shows that while the population of Milwaukee has increased but 93 per cent since 1890, the number of consumers has increased 640 per cent, the sale of gas 645 per cent and the sales per capita 284 per cent. It was shown that while the average consumption of gas in the cities of the country was 5190 cu. ft. per capita, the consumption in Milwaukee is 7360 cu. ft. per capita. Inasmuch as this showing was made possible by the excellent service rendered and a continued effort to secure new business, it was contended that the profit on all gas sold in excess of the average should be capitalized at 8 per cent and be included in the total valuation as going value. The present rates of the Milwaukee Gas Light Company range from a rate of 75 cents for the first 1000 cu. ft. per month to a rate of 50 cents for all gas used in excess of 1000 cu. ft per month. The commission has recently issued three pamphlets containing the rate schedules of every electric light, gas and heating company in the State which makes a report to the commission.

OHIO COMMISSION

Some headway has been made with a bill in the Legislature which will require the commission to make a valuation of every public-service company in the State, in order to determine whether the rates charged for service are fair or not. The bill provides that the work shall be done by instructors connected with the engineering department of the Ohio State University and students of the department. The fees for the work are to be paid from the funds of the commission and of the university.

The complaints of citizens of Cincinnati against the meter charge made by the Cincinnati Gas & Electric Company will be heard in the council chamber in Cincinnati on Feb. 27 and 28. The company filed an answer denying any unjust discrimination or excessive or unreasonable charges.

Current News and Notes

BROOKLYN EDISON COMPANY TO ENTERTAIN CONTRACTORS.—The Edison Electric Illuminating Company of Brooklyn will give its annual dinner to the electrical contractors of that borough at the Union League Club on Feb. 15.

* * *

TITANIC FUND FOR CORNELL UNIVERSITY.—A fellowship in mechanical and electrical engineering has been founded at Cornell University by Mr. and Mrs. Eugene Meyer, of New York City, who have given $10,000 in memory of their son, Edgar J. Meyer, who was graduated from Sibley College in 1905 and perished in the wreck of the *Titanic*.

* * *

ELECTRIC SHOW IN A TENT FOR CHARITY.—For the benefit of the public playgrounds of New Orleans an "electric marvel show" was held in a circus tent at Elk Place, New Orleans, during Mardi Gras week, Jan. 27. Besides many electrical novelties, exhibitions of wireless telegraphy, the X-ray, etc., a number of manufacturers displayed their products, and the New Orleans Railway & Light Company, through its president, Mr. Hugh McClosky, and its contract agent, Mr. W. E. Clement, substantially aided the interests of the show and fund. Mr. E. H. McFall, a well-known electrical supply dealer, acted as manager for the show.

* * *

INTERSTATE COMMERCE COMMISSION PROMULGATING UNIFORM ACCOUNTS FOR TELEPHONE COMPANIES.—A uniform system of accounts for telephone companies having annual operating revenues in excess of $50,000 has been promulgated by the Interstate Commerce Commission, taking effect the first of this year. Such companies are divided into two classes, the dividing line being at annual operating revenues of $250,000. The accounting system is issued under the authority contained in Section 20 of the act to regulate commerce. The commission has under consideration the promulgation of a system of accounts for smaller companies to be issued at a later date.

* * *

TELEGRAPHING 40,000 WORDS AN HOUR.—The first American demonstration of the Pollak-Virag system of rapid telegraphy, with which, it is declared, 40,000 words can be dispatched per hour, was given by Antoine Pollak, the inventor, at New York, Jan. 31. By means of a beam of light controlled by motions at right angles, the receiving machine produces written characters on sensitized paper. Owing to the rapid succession of impulses involved, the system is limited in its use over very long inductive iron-wire lines, although entirely feasible within present telephonic ranges using copper circuits. It is reported that during a recent demonstration in France messages were sent 900 miles with this system.

* * *

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.—As was noted in the *Electrical World* Jan. 25, the Society for Electrical Development, Inc., will shortly issue a broadcast invitation to the electrical industry to attend a conference for the purpose of discussing concrete methods for carrying on the publicity campaign through which the society hopes to effect the co-operative movement for benefiting the entire electrical industry. This conference will be held in New York on March 4 and 5. Details of an exceedingly comprehensive program are now being completed. Many of the leaders in all branches of the central-station and electrical manufacturing industries have already accepted invitations to address the meeting on pertinent subjects and acceptances are being awaited by the committee from a number of other men whose views on the purposes of the society and methods of effecting these will be of great interest to those present.

Tour of Jupiter F. E. Watts.—Local organizations of the Jovian Order on the Pacific Coast from Spokane to Los Angeles have this week received a visit from Mr. F. E. Watts, head of the order, who is making a tour of visitation which, when completed, will include twenty-five cities of the middle and far West. In many of his speeches to his brother Jovians Mr. Watts has dwelt upon the need for co-operation by the order in bringing about patent reform and in other activities for the good of the electrical industry. State and local officials have very generally joined with the electrical men in the gatherings where the Jupiter has been entertained. His itinerary next week includes Salt Lake City, Denver and Omaha.

* * *

Pulmotor Shown at Jovian Luncheon.—At the New York Jovian luncheon in New York this week a practical demonstration of the pulmotor was given by Mr. E. W. Gorry, chief operator of the United Electric Light & Power Company. The "patient" whose resuscitation was successfully accomplished was Mr. J. F. Lufkin, of the same company. The instrument used was one of the forty-five pulmotors with which the New York electric and gas companies are now equipped. Besides showing the pulmotor in operation, Mr. Gorry thoroughly explained the necessary manipulation of the patient, the positions in which he is placed and the means necessary to keep the throat unobstructed and to prevent the pulmotor acting as a stomach pump in addition to inflating and deflating the lungs. Statesman Becker, who presided at the luncheon, announced that the next rejuvenation in New York would be held on March 10, at which time it is expected that 125 candidates will be admitted.

* * *

SOCIETY MEETINGS.

Columbia Electrical Engineering Society.—At a meeting of the Electrical Engineering Society of Columbia University to be held on Feb. 13 at 8:15 p. m. in the Engineering Building, 117th Street and Broadway, Mr. Frederick B. Corey, of the Union Switch & Signal Company, will give an illustrated talk on "Railway Switch Practice."

* * *

Boston Engineers' Club.—Among the speakers at the opening of the Engineers' Club of Boston, Mass., on Jan. 25 were Mr. George Westinghouse, Colonel George W. Goethals and President A. Lawrence Lowell of Harvard University. The officers of the club are: President, Mr. Ira N. Hollis; vice-presidents, Messrs. Charles L. Edgar and Charles T. Main; treasurer, Mr. Eliot Wadsworth, and secretary, Mr. Luzerne S. Cowles.

* * *

Jovian Rejuvenation at Baltimore.—A rejuvenation and banquet of the Baltimore Jovians on Feb. 1 at the Hotel Emerson was addressed by Prof. Charles F. Scott, past-president of the A. I. E. E. Statesman Melvin H. Jones presided at the banquet, and in the course of his remarks said that Jovian progress in Baltimore in the past year was "only the yawn of a giant just waking up. When we really get thoroughly awake we will show Baltimore a real electrical shock."

* * *

Annual Banquet of Lynn Section of A. I. E. E.—The second annual banquet of the Lynn Section of the American Institute of Electrical Engineers was held at the Boston City Club, Boston, Mass., on Jan. 25. Prof. Elihu Thomson acted as toastmaster, and Mr. Frederick P. Fish, the well-known attorney, spoke on "The Recall of Judges and the Referendum, or the Judicial Decision of the People." The Lynn Section has now a membership of 510, making it the banner local section of the A. I. E. E.

Institute of Operating Engineers' Lecture.—The Institute of Operating Engineers has secured Dr. Frederic Bannerth, consulting chemist, to give three talks on Feb. 15, March 15 and April 19 on the following subjects: "Fuel, Combustion and Fire-Room Principles," "Water for Boiler Purposes" and "Lubricants and Their Value." The lectures will be given in the order named to members and non-members in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, on the dates mentioned at 8:15 p. m.

* * *

Minnesota Contractors.—A meeting of the Minnesota Electrical Contractors' Association was held in the Builders' Exchange, St. Paul, on Feb. 1. In a general discussion it was agreed that the growth of the association in numbers and influence would be a decided benefit in raising the standard of the electrical construction business in the State. The St. Paul members gave a banquet to the visitors. The next meeting will be held in Minneapolis on June 20. Mr. G. M. Jones, of Minneapolis, is secretary of the association.

* * *

Organization of Chicago Jovian Lunch Club.—At a meeting held on Feb. 3, attended by sixty-five members of the Jovian Order living in Chicago, a Chicago Jovian Lunch Club was formed. For the present the new club will meet at luncheon at the Grand Pacific Hotel every Monday at 12:15 p. m. Mr. George C. Richards, statesman for Northern Illinois, is chairman, and Mr. M. S. Hart is secretary. The club will begin an active campaign for new members, and it is probable that several rejuvenations will be held before the great rejuvenation to take place during the N. E. L. A. convention in Chicago on June 2-6.

* * *

Jovian Chapter, St. Louis Electrical League.—At its annual meeting and dinner, held at the Mercantile Club, St. Louis, Jan. 28, the Jovian Chapter of the St. Louis League of Electrical Interests entertained as its guests the visiting delegates of the Western Association of Electrical Inspectors. Mr. Sam A. Hobson, the retiring president, presented Secretary Ell C. Bennett with a handsome leather case in token of the league's appreciation of his services. Mr. Bennett's report showed a treasury balance of $800. Upon motion of Mr. W. O. Layman a resolution was passed urging the selection of St. Louis as the place of next year's Jovian convention and the election of Mr. W. N. Matthews, of that city, as national Jupiter. St. Louis chapter officers for the year were unanimously elected as follows: President, A. C. Einstein; vice-president, W. N. Matthews, and secretary-treasurer, E. C. Bennett. An attendance of 400 marked the meeting and banquet.

* * *

Meeting of Hamilton Section, N. E. L. A.—Over 100 members attended the meeting of the Hamilton (Ont.) Section of the National Electric Light Association on Jan. 22 to wish President Thomas F. Kelly success in his new undertaking. As has been already announced in these columns, Mr. Kelly has severed his connection with the Hamilton Electric Light & Power Company and accepted the post of sales agent of the Dayton (Ohio) Power & Light Company. The meeting was therefore very largely a farewell reception to Mr. Kelly, who was presented with a cabinet of silver by the employees of the Hamilton Electric Light & Power Company, and who in turn presented a life-size photograph of himself to the section. Previous to the presentation there was an illustrated lecture on the Panama Canal by Mr. George W. Magalhaes. Addresses were also made by President-elect L. W. Pratt of the Hamilton Section; Mr. George W. Ames, past-president of the Buffalo Section, and Messrs. George D. Fearman, W. G. Angus and Charles G. Choate.

Gas-Engine-Driven Central Station

High Load-Factor Obtained by the Titusville Light & Power Company in the Natural Gas and Oil Regions in the Northwestern Part of Pennsylvania

TITUSVILLE, Pa., is said to be one of the wealthiest cities per capita in the United States. It has a population of approximately 9000 and is situated on Oil Creek, in Crawford County, about midway between Buffalo and Pittsburgh, on the Chautauqua division of the Pennsylvania Railroad and at the terminus of the Dunkirk, Allegheny Valley & Pittsburgh branch of the New York Central & Hudson River Railroad Company. Surrounded by an agricultural and farming community, Titusville presents many features as a manufacturing town. Primarily, it is the home of several of the most influential oil men in the country and contains the principal offices of the Tidewater Oil Company, Pure Oil Company, South Penn Oil Company, Carter Oil Company, United States Pipe Line Company, National Oil Company, Derrick Oil Company, and possibly twenty other smaller companies. Both the Tidewater Oil Company and the United States Pipe Line Company have important pumping stations there, and in fact all the oil from the Illinois field for the East is brought in pipe lines through Titusville.

In addition to the large refineries of the Pennsylvania Paraffine Works, the American Oil Works and the Titusville Oil Works there are several important manufacturing concerns located there. Among these are the American Radiator Company, the largest manufacturer of steam and hot-water radiators; the Cyclops Steel Works, which make a specialty of high-grade tool steel; the Titusville Forge Company, which manufactures iron forgings for all kinds of work; the Titusville Iron Company, which manufactures gas and steam engines, boilers, tanks, pumping rigs and specialties for the oil industry; the acid works of the Grasselli Chemical Company; extract works; the Queen City Tannery, owned by the United States Leather Company; a silk mill, cutlery works, a chair factory, several woodworking concerns and smaller machine shops.

The Titusville Light & Power Company is incorporated under the laws of Pennsylvania and at present owns the only franchise for supplying electricity in Titusville. For this privilege it pays the city by lighting its city hall, hose houses and jail, so long as no competing franchise is granted. The company's power house is located on a rectangular piece of ground, 70 ft. by 170 ft., abutting on Franklin Street, a principal business street within 200 ft. of the business center. The Pennsylvania Railroad Company has a switch on one side and the New York Central Railroad Company a switch on the other side of the property. An ample supply of water is secured from a 65-ft. drilled well capable of supplying at least 10,000 gal. of water an hour continuously.

The station building itself was erected during the summer of 1908 and is 62 ft. by 42 ft., all in one room with a heavy concrete floor, brick walls and steel roof. A steel runway carries a 10,000-lb. crane the entire length of the building, 20 ft. above the floor. The generating equipment comprises two 180-hp, three-cylinder, 14-in. by 18-in. vertical-type gas engines each directly connected to a 125-kw, 2300-volt, three-phase, 60-cycle alternator with directly connected 6-kw exciter, and one four-cylinder, 250-hp vertical-type gas-engine unit with the same cylinder dimensions. This unit drives a 200-kw generator. At present a fourth unit, similar to the third, is being installed. The gas engines were built by the Titusville Iron Company, the works

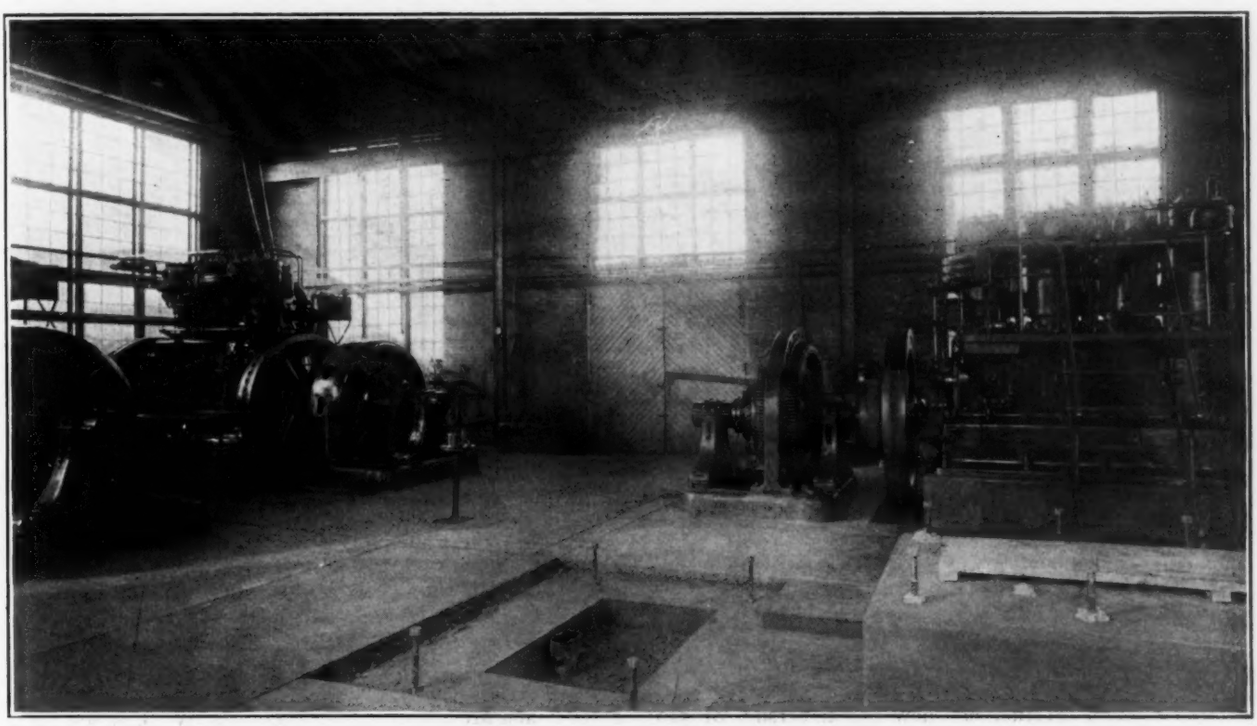


FIG. I—INTERIOR VIEW OF THE TITUSVILLE STATION

of which are located on the property adjoining the electric-light plant. The latter has the constant attention of the iron company's engineers, who use the plant as a show-room for prospective gas-engine purchasers. A Deming triplex pump geared to a 5-hp, three-phase, 220-volt motor supplies all the necessary water for plant purposes, and a Bury double-acting air compressor belted to a 5-hp, three-

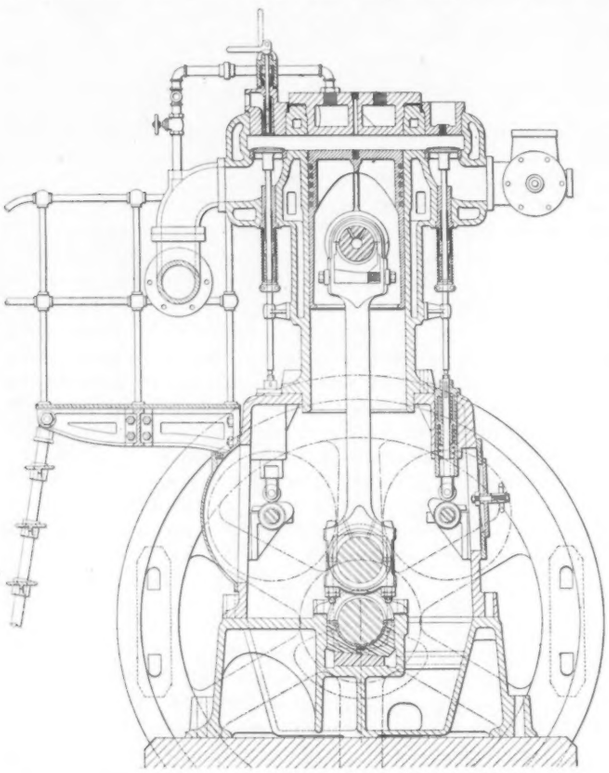


FIG. 2—SECTIONAL VIEW OF ONE OF THE GAS ENGINES

phase, 220-volt motor supplies air for starting the engine, driving a pneumatic tool and drawing oil and gasoline from the storage tank. A steel tank holding 110 cu. ft. is used to store air under a pressure of 160 lb., and two tanks each of 119-gal. capacity store the necessary oil and gasoline. The latter tanks are buried outside the building and are equipped with the necessary piping, air connections, etc., to bring the oil and gasoline into the plant. A 1-kw motor-generator set supplies 110-volt direct current for telegraph purposes and also for engine-ignition purposes.

The engines are of the vertical, single-acting, four-stroke cycle type governed by automatically controlling a gas and air mixture of practically constant quality. The cylinders are bolted to the top of an inclosed crank case which serves the added purpose of providing means for accomplishing copious oil-bath lubrication of all working parts. Natural gas containing approximately 1000 effective heat units per cubic foot is supplied to the engines at a pressure not exceeding ½ lb. per square inch by pressure gage and not less than 4 in. pressure by water column. The cylinder and the cylinder heads are water-jacketed, but there is no water connection between the heads and the cylinders. Both have ample independent supply to permit the engines to be operated at full load continuously without overheating. The inlet and exhaust valves are of the poppet type and are operated by cam and spring valve gear. Each exhaust valve is provided with a cam to enable the operator to relieve the compression at will for starting purposes.

Separate air and gas valves are contained in the mixing valve. The air and gas valves are of the cylindrical type operated vertically by the governor and have suitable ports arranged so that they can be rotated by hand independently of each other so as to vary the size of the port opening for air and gas to get the best mixture. A governor of the fly-ball type is geared directly to the cam shaft and operates the mixing valve by means of a shaft and levers. A dual system of ignition is employed; one, a jump spark with magneto, and the other of positive make-and-break type, both being driven from the cam shaft. Provision is made for starting the engine automatically by means of a starting valve which is operated by a cam on the cam shaft and admits compressed air to one of the cylinders. Between 25 per cent of full load and full load the speed of the engine does not vary more than 2 per cent either way from the mean speed for all reasonable usual changes of load during normal operation. In case of unusual and sudden large changes of load the speed momentarily exceeds these limits. Standard switchboard equipment is employed, and in addition to the lightning protection in the station graded shunt and non-arcing lightning arresters are used on the line to protect the large transformers and the motor installations.

There is nothing unusual about the station except perhaps the simplicity of the layout and the fact that until recently no reserve apparatus was installed. Located as the company is in the heart of a natural gas and oil region, competition from both of these forms of fuel is of course to be expected. The city of Titusville, moreover, owns and operates its own street-lighting plant. The generating equipment for the latter, which has been in operation since 1889, is located in the water works and furnishes energy for 152 Brush open-arc lamps rated at 9.6 amp. The plant is rather antiquated and is unable to furnish additional lighting service for the city. Inasmuch as there are no funds available for improving the municipal lighting installation, the Titusville Light & Power Company will in all probability be called upon in the near future to do some of the street lighting of the city.

The company purchases natural gas at a net rate of $0.28 per 1000 cu. ft., and this rate is given to every other consumer of natural gas in Titusville. It is significant, therefore, that in the face of these competitive conditions the company has increased its output three and one-half times in the last two years and acquired quite a motor load. The

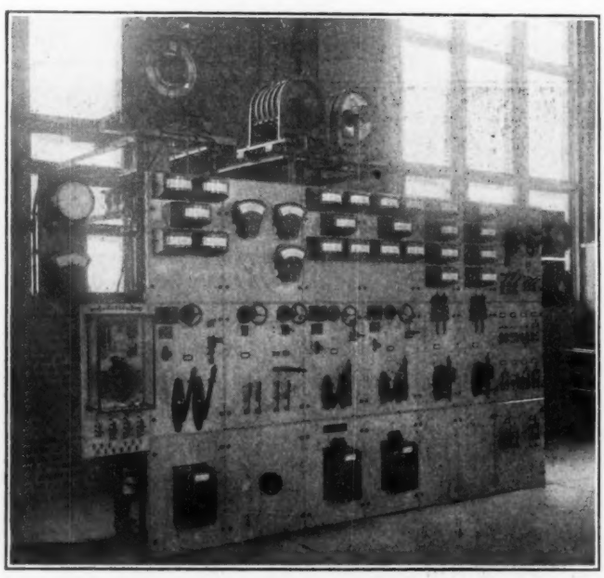


FIG. 3—SWITCHBOARD IN TITUSVILLE STATION

latter load is about four times the size of the lighting load, although the revenue derived from each is about the same. By a judicious use of synchronous apparatus on certain of the motor circuits the average power-factor of the system is maintained at 90 and over. The company has been fortunate in the acquisition of certain installations possessing excellent diversity factors. There is, therefore, no evening

peak such as is found in systems where the motor load and the lighting load overlap. The maximum load is encountered shortly after 9 o'clock in the morning and again in the early afternoon, and the load curve is lowest between midnight and about seven in the morning. Under these conditions a fairly good load-factor is to be expected, and the Titusville Light & Power Company's system possesses a load-factor ranging between 70 and 80 per cent. The station is operated at minimum labor expense, there being two twelve-hour shifts with a single engineer in charge. The day operator receives $80 a month and the night operator $65 a month; so that the total labor cost for operating the station is $145 a month.

It was felt at the time this load was taken over that there would be a very marked increase in the station demand, and some anxiety was manifested by the forge works as to its effect on the company's system. However, much to the surprise of all concerned, the diversity factor of the installation was such that the demand on the station was increased only slightly. The Titusville Iron Works, which operate a gas-engine-driven isolated plant, contracts with the central station for service extending from about 10 p. m. to 4 a. m., during which time its engines are shut down. Having a direct-current equipment, the iron works have installed a motor-generator set to carry the night load, seeing that the central station supplies only alternating current. The set is rated at 60 kw and the load comes on at a time when the system is delivering minimum output. Since the iron works are enabled to operate at night without keeping their own plant in operation, with its necessary attendants, considerable saving is effected by employing central-station service.

The number of residences supplied with electricity is more than 200, about 100 of these being equipped with "Excess" indicators. For the latter service a charge of 1 cent a watt a month, with a minimum bill of $1.25 a month, is in force. The base meter rate for residence service is 12 cents per kw-hr. There is a very little competition encountered with natural gas, despite its cheapness for store lighting, and where 50 kw-hr. is consumed monthly the rate is 9 cents per kw-hr. less a discount of 5 per cent. for prompt payment.

The company carries a full line of electrical supplies in its office in the Post Office building, on Central Avenue, and engages in contracting work also. Incandescent lamps are sold at list prices and all goods are sold at a profit. Such wiring work as the company does is also done at a profit. In a great many of the residences the meters are placed on the back porches, a custom which obtains in many Pennsylvania towns and by reason of which meters are read expeditiously and with minimum expense.

Every precaution is taken to keep down the operating expense without sacrifice of reliability. Of all the apparatus the gas engines are probably most prone to cause unexpected trouble, but, inasmuch as these are manufactured next door, the station is amply guarded in this respect. Thus far, however, the engines have given remarkable service. A representative copy of the station log, reproduced herewith, shows a fuel consumption of 14.8 cu. ft. of gas per kw.-hr. The cost of electrical energy delivered at the switchboard, including fuel, engineers' wages, supplies, repairs to building, machinery and equipment, is less than 8 mills per kw-hr., which is remarkably low for so small a station. Mr. E. F. McCabe is the general manager of the Titusville Light & Power Company.

Titusville Light and Power Company

DAILY STATION REPORT. 12 M. November 6 1912

UNIT No. 1			UNIT No. 2			UNIT No. 3		
STARTED	STOPPED	HOURS RUN	STARTED	STOPPED	HOURS RUN	STARTED	STOPPED	HOURS RUN
On	10:40	10 ¾	On	On	24	On	11:30	11½
11:30	On	13				6:30	On	5½
Total Hours Run 23¾			Total Hours Run 24			Total Hours Run 17		
Average Load K. W.			Average Load K. W.			Average Load K. W.		
Gas Meter No. 1 Reads 6,246,560			Gas Meter No. 2 Reads 5,755,150			Gas Meter No. 3 Reads 7,831,370		
Yesterday's Reading 6,218,310			Yesterday's Reading 5,724,660			Yesterday's Reading 7,797,800		
Cubic Feet Gas Used 28,250			Cubic Feet Gas Used 30,490			Cubic Feet Gas Used 33,570		
Electric Meter No. 1 Reads 3,826			Electric Meter No. 2 Reads 4,034			Electric Meter No. 3 Reads 99,250		
Yesterday's Reading 1,903			Yesterday's Reading 1,919			Yesterday's Reading 97,070		
K. W. Hours Generated 1,923			K. W. Hours Generated 2,116			K. W. Hours Generated 2,180		
Cu. Ft. of Gas / K. W. Hrs. 14.1 Cu. Ft. per K. W. Hr.			Cu. Ft. of Gas / K. W. Hrs. 14.4 Cu. Ft. per K. W. Hr.			Cu. Ft. of Gas / K. W. Hrs. 15.3 Cu. Ft. per K. W. Hr.		

Total Hours Run ..... Average Load ..... K. W. Hours Oil Used ..... Quarts

Total Gas Used 92,316 Cubic Feet, divided by Total Out-Put 6,219 K. W. Hours = 14.8 Cubic Ft. Per K. W. Hrs.

REMARKS: Maximum Kw. 349 Average Load 24 hrs. 259.12 kw

Time 1 p.m. to 2 p.m. Load Factor 74.2 per cent

A B C

Amp. 300 100 100 100 Power Factor 90 per cent

Signed Alan G. Dame ENGINEER

FIG. 4—STATION LOG OF THE TITUSVILLE LIGHT & POWER COMPANY

There are over 102 motors connected to the company's system with an aggregate rating of approximately 1000 hp. Most of the large installations are driven directly by 2300-volt motors, thus eliminating transformer losses. The largest load fed from the system is that of the Titusville Forge Works, which aggregates 600 hp. A part of the equipment comprises a 200-kw synchronous converter which is over-excited so as to improve the power-factor of the system. The works were formerly operated from a gas-engine installation, but after a thorough investigation, which took cognizance of the troubles caused by gas-engine mishaps, it was decided to employ central-station service. The rate is 1.75 cents per kw-hr. for a twenty-four-hour load.

International Scandinavian Transmission System

Comparative costs of generating equipment and proposed 200-mile line from Trollhättan to Copenhagen —90,000-volt direct-current system recommended

NEGOTIATIONS have been under way for some time between the Swedish and Danish governments for the sale and transmission of electrical energy from Trollhättan, Sweden, to Copenhagen. The commercial feasibility of the project has been investigated by the Swedish government, which engaged Mr. Carl A. Rossander, of the Elektriska Pröfningsanstalten, Stockholm, to report on the matter. Mr. Rossander was assisted in his investigations by Messrs. Torsten Holmgren, of Trollhättan, and Mr. Georg Centerwall, of Stockholm, and the following information is contained in their report to the Swedish government.

The present generating stations in Copenhagen being too small to meet the increasing demand for electrical energy in the city and its suburbs, it was proposed either to build a new modern steam station or to purchase energy from the large hydroelectric system recently erected by the Swedish government at Trollhättan and transmit it at high tension to Copenhagen. In order to obtain exact knowledge of the relative merits of the prevailing transmission schemes for the project in hand, a thorough study was made of the existing conditions, the probable ultimate demand, production costs in a modern steam generating station at Copenhagen, and the cost of transmitting energy from Trollhättan across the strait to Denmark and thence on to Copenhagen.

The city and suburbs of Copenhagen have a population of 581,000 and are at present served by three central steam stations and a number of isolated plants. Extensions or improvements of these stations were not considered for the purpose of furnishing the whole supply, but in case energy should be purchased from Trollhättan it is proposed to retain these stations with their storage-battery equipments in case of interruptions on the high-voltage system and also for carrying the peak load. The Trollhättan plant, which was described in the *Electrical World* Jan. 11, 1913, is designed for 100,000 hp generated by ten 10,000-hp turbo-generators, of which eight are now installed. The remaining two units could be used for the generation of energy for sale to Copenhagen. During 1911, when the investigation was made, the demand in Copenhagen was about 24,000 kw and the yearly energy consumption 65,000,000 kw-hr. The load-factor was about 31 per cent. The demand for 1913 is estimated to be about 35,000 kw and the yearly energy consumption about 95,000,000 kw-hr.

TABLE I—COST PER KILOWATT FOR STEAM TURBO-GENERATOR STATION AT COPENHAGEN

7000-kw turbo-generators with condensers and auxiliaries	$12.62
Boilers with economizers, pumps and piping	12.12
Cranes, etc.	2.08
Switchboard	1.35
Building	3.40
Real estate	2.70
Miscellaneous and incidentals	0.33
Total	$34.60

Cost of Modern Steam Plant at Copenhagen

The value of electrical energy at Copenhagen can, of course, best be determined from the cost of generation in that city. For this purpose quotations were obtained for a complete steam turbo-generator plant, the cost of which per kilowatt is given in Table I. Table II gives the fixed annual expense per kilowatt. In this connection it should be mentioned that the estimates do not include cost of administration, taxes, insurance, etc., and that the rating of the proposed plant corresponds to the present demand. The variable annual expenses for the proposed plant, including cost of fuel, oil, coal transportation and storage, would amount to 0.4 cent per kw-hr., based upon the manufacturer's guarantee of steam consumption and the market price of fuel at Copenhagen. The cost of generating electrical energy at Copenhagen would, therefore, be a fixed charge of $5 per kw per annum plus 0.4 cent per kw-hr.

TABLE II—FIXED ANNUAL EXPENSES PER KILOWATT FOR STEAM TURBO-GENERATOR STATION AT COPENHAGEN

Interest, 5 per cent on $34.60		$1.73
Depreciation:		
Turbo-generators, condensers and auxiliaries, 3 per cent	$0.38	
Boilers, cranes, switchboard, miscellaneous, 4.6 per cent	0.73	
Buildings, 0.5 per cent	0.02	
		$1.13
Maintenance:		
Turbo-generators, condensers and auxiliaries, 1.5 per cent	$0.19	
Boilers, 4 per cent	0.49	
Building, 1 per cent	0.03	
Switchboard, cranes, miscellaneous, 2.5 per cent	0.09	
		0.80
Wages		1.34
Total		$5.00

The operating expenses of the present plants are of interest. Table III shows the variable annual expense per kilowatt-hour during 1910. Assuming that the plants would be used as reserve and for carrying the peak loads, the figures would be somewhat reduced. The cost of maintenance and supplies would be decreased by about 75 per cent and the total variable annual expense per kw-hr. would then be as follows: Copenhagen, 0.76 cent; Fredriksberg, 1.07 cents; Skovshoved, 1.05 cents. The fixed charges, including interest, depreciation, wages, etc., are not considered, as they would remain practically the same as under present conditions.

TABLE III—VARIABLE ANNUAL EXPENSES PER KILOWATT-HOUR FOR PRESENT STEAM GENERATING STATIONS

Station	Cost of Fuel, Cents	Cost of Oil, Cents	Maintenance and Supplies, Cents	Total Cost, Cents
Copenhagen	0.65	0.02	0.37	1.04
Fredriksberg	0.96	0.05	0.24	1.25
Skovshoved	0.97	0.03	0.19	1.19

Transmission from Trollhättan

In planning a transmission system from Trollhättan to Copenhagen, a distance of 204 miles, a matter of primary importance was the amount of energy which could be transmitted with greatest advantage. As stated above, it was estimated that during 1913 the demand would be 35,000 kw during 2700 hours. On account of the length of the transmission line and the consequent large expen-

diture involved a comparatively large load-factor would be essential in order to make the project commercially successful. To supply the whole demand at a load-factor of, say, 30 per cent would not be feasible, as the price in that case would be considerably higher than that of energy

TABLE IV—FIXED ANNUAL EXPENSES FOR ALTERNATING-CURRENT SYSTEM

	Interest, per Cent	Depreciation, per Cent	Maintenance, per Cent	Total, per Cent
Hydraulic works	4	3.4	0.7	8.1
Buildings	4	3.4	1.0	8.4
Turbines	4	3.4	2.0	9.4
Generators	4	3.4	2.0	9.4
Transformers	4	3.4	2.0	9.4
Switch gear	4	3.4	2.5	9.9
Converters and frequency changers	4	3.4	2.0	9.4
Auxiliaries (cranes, pumps, etc.)	4	3.4	3.0	10.4
Transmission poles of iron	4	3.4	2.5	9.9
Iron cable	4	8.3	1.5	13.8
Insulators	4	3.4	2.5	9.9
Copper conductors	4	2.6	0.2	6.8
Submarine cables	4	3.4	5.0	12.4

generated at a steam plant in Copenhagen. Further investigations proved that one-third of the maximum demand, or about 11,600 kw, would be required during 5200 hours. As this corresponds to 20,000 hp at Trollhättan, which is equal to the output of the two available generating units the following calculations have been made on that basis. The energy consumption would, however, probably be considerably higher than the figures indicate, as it is proposed to sell the energy at a fixed price per kilowatt plus a very low charge per kilowatt-hour, in which case it would be to the purchaser's interest to distribute energy at a low rate, for instance, during the night, and to utilize the present storage-battery system to the largest possible extent.

The route of the proposed transmission line is along the west coast of Sweden from Gothenburg to Helsingborg, where it crosses the Strait of Öresund to Helsingör, and thence along the coast of Denmark to Copenhagen. Both alternating-current and direct-current systems have been considered for generation and transmission. At present 25-cycle alternating current is generated at Trollhättan and 50-cycle alternating current at Copenhagen.

Cost of Three-Phase Generating Equipment and Transmission Lines

This system involves the installation of turbines, three-phase generators, transformers, transmission line, submarine cables, transformer stations in Helsingborg, Helsingör and Copenhagen and frequency changers in Copenhagen for the generation and transmission of 20,000 hp measured at the turbines at Trollhättan.

Assuming a 100,000-volt line, calculations as to the most economical size of copper conductor show that a cross-section between 100,000 circ. mils and 200,000 circ. mils could be used with equal advantage, and the following estimates were based on 150,000-circ. mil conductors. The total length of the proposed line is 204 miles with a single three-wire circuit on iron poles with suspension insulators. At Helsingborg it is proposed to step down the tension to 20,000 volts and to carry the energy by four three-phase submarine cables, each 3 by 187.435 circ. mils, across the Strait of Öresund to Helsingör, a distance of 3.4 miles. From Helsingör to Copenhagen either 20,000 volts or 100,000 volts can be used, the latter being the more economical.

If the generators have an efficiency of 96 per cent, all the transformers 98.5 per cent, and the frequency changers at Copenhagen 90 per cent, there would be available for distribution at 10,000 volts 11,600 kw at 25 cycles or 10,440 kw at a frequency of 50 cycles.

In estimating the fixed annual expenses (Table IV) 4 per cent interest has been allowed on the investment. The life of the material is considered to be about twenty years except the steel cable, the life of which is limited to ten years. No value has been set on any material after the time of depreciation except for the copper conductors, which are supposed to sell at 25 per cent of first cost. The wages of linemen have been estimated at $11 per mile a year, and the sum allotted for wages and lubricating material at the generator station at Trollhättan and at the converter station at Copenhagen is $3,200, and at each of the transformer stations at Helsingborg, Helsingör and Copenhagen about $1,300.

In the total expense (Table V) is included the whole project from the turbines at Trollhättan to and including the transformer station at Copenhagen. The total cost, including the frequency converter station at Copenhagen, is given separately. Twenty per cent has been added to the actual cost to cover incidentals and administration.

Cost of Direct-Current Generation and Transmission

For direct-current transmission the Thury constant-current system at 90,000 volts was considered. Submarine cable can be obtained for that voltage and consequently no transformer stations would be required at Helsingborg and Helsingör. The Trollhättan plant is at present arranged for two future 10,000-hp turbines, but a direct-current system would require instead four 5000-hp machines each driving five direct-current series-connected generators. The Thury system would also involve a converter station at Copenhagen for changing from direct current to 50-cycle alternating current.

TABLE V—COST OF GENERATING AND TRANSMITTING ALTERNATING CURRENT AND EVENTUALLY CONVERTING IT INTO 50-CYCLE ALTERNATING CURRENT AT COPENHAGEN

	Cost of Installation	Annual Expenses
Generating station:		
Two 10,000-hp turbines and auxiliaries	$81,000	$7,600
Three-phase generators	70,500	6,600
Transformers at Trollhättan	31,500	2,950
Switch gear	27,000	2,650
Wages, oil and supplies	.....	3,200
	$210,000	$23,000
Transmission line:		
Iron poles, including erection, at $1,350 per mile	$275,000	$27,200
Insulators, at $390 per mile	80,000	7,900
Iron cable, at $87 per mile	17,900	2,500
Copper conductors, at $1,525 per mile	310,100	21,000
Wages for linemen	.....	2,200
	$684,000	$60,800
Three transformer stations:		
Buildings	$40,500	$3,400
Transformers	81,000	7,600
Instruments	30,500	3,000
Auxiliaries	40,500	4,200
Wages and supplies	.....	4,000
	$192,500	$22,200
Submarine cables:		
Four cables, each 3.4 miles, at $5,780 per mile	$78,600	
Loading on steamer, laying and splicing	20,000	$14,200
Freight and marine insurance	5,400	
Anchorage at cables	9,500	
	$113,500	$14,200
Incidentals	$231,500	$24,100
Total	$1,431,500	$144,300
Frequency-converter station:		
Three frequency changers, 25 cycles to 50 cycles; total 11,600 kw	$122,000	$11,400
Switch gear	13,500	1,300
Wages, oil and supplies	.....	3,200
Incidentals	27,000	3,200
	$162,500	$19,000
Grand total	$1,593,000	$163,300

A plan for the generation of 25-cycle alternating current at Trollhättan and its conversion to direct current for transmission was studied. Either impregnated wooden poles or iron poles might be employed and a ground return. Estimates were made for this as well as for ordinary metallic-return systems. For the direct-current generators and mo-

TABLE VI—COST OF GENERATING AND TRANSMITTING DIRECT CURRENT AND EVENTUALLY CONVERTING IT INTO 50-CYCLE ALTERNATING CURRENT AT COPENHAGEN

	WOODEN-POLE TRANSMISSION LINE				IRON-POLE TRANSMISSION LINE			
	GROUND RETURN		METALLIC RETURN		GROUND RETURN		METALLIC RETURN	
	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses
Changes for turbines	$40,500	$3,400	$40,500	$3,400	$40,500	$3,400	$40,500	$3,400
Isolating machinery	2,700	200	2,700	200	2,700	200	2,700	200
	$43,200	$3,600	$43,200	$3,600	$43,200	$3,600	$43,200	$3,600
Generating equipment:								
Four 5000-hp turbines	$81,000	$7,600	$81,000	$7,600	$81,000	$7,600	$81,000	$7,600
Direct-current generators and auxiliaries	216,000	21,400	216,000	21,400	216,000	21,400	216,000	21,400
Wages, oil and supplies	.....	3,200	.....	3,200	.....	3,200	.....	3,200
	$297,000	$32,200	$297,000	$32,200	$297,000	$32,200	$297,000	$32,200
Submarine cables:								
Two cables, each 3.4 miles, 150,000 circ. mils	$24,600	$5,400	$24,600	$5,400	$24,600	$5,400	$24,600	$5,400
Laying of cables, etc	18,900		18,900		18,900		18,900	
	$43,500	$5,400	$43,500	$5,400	$43,500	$5,400	$43,500	$5,400.
Transmission line:								
Poles, including erection	$125,100	$13,000	$204,000	$21,100	$178,000	$17,700	$264,000	$26,100
Insulators	31,900	3,200	28,400	2,800	32,900	3,200	28,400	2,800
Iron cable	17,800	2,500	17,800	2,500	17,800	2,500	17,800	2,500
Copper conductors	166,200	11,300	470,000	32,000	166,000	11,300	470,000	32,000
Wages for linemen	.....	2,200	.....	2,200	.....	2,200	.....	2,200
	$341,000	$32,200	$720,200	$60,600	$394,000	$36,900	$780,200	$65,600
ncidentals	$140,000	$14,400	$220,000	$19,700	$153,000	$15,100	$227,000	$20,700
Total	$864,700	$87,800	$1,320,900	$121,500	$931,400	$93,200	$1,390,900	$127,400
Frequency-converter station:								
Direct-current motors and auxiliaries	$221,000	$22,000	$212,000	$21,000	$221,500	$22,000	$213,500	$21,000
Three-phase generators	51,500	4,800	48,500	4,600	51,500	4,800	48,600	4,600
Switchboard and switch gear	10,800	1,100	10,800	1,100	10,800	1,100	10,800	1,100
Wages and supplies	.....	3,200	.....	3,200	.....	3,200	.....	3,200
Incidentals	54,000	6,200	51,500	5,900	54,000	6,200	51,500	5,900
	$337,300	$37,300	$322,800	$35,800	$337,800	$37,300	$324,400	$35,800
Grand total	$1,202,000	$125,100	$1,643,700	$157,300	$1,269,200	$130,500	$1,715,300	$163,300

TABLE VII—COST OF GENERATING ALTERNATING CURRENT AND CONVERTING IT INTO DIRECT CURRENT AT TROLLHÄTTAN, TRANSMITTING DIRECT CURRENT AND EVENTUALLY CONVERTING IT INTO 50-CYCLE ALTERNATING CURRENT AT COPENHAGEN

	WOODEN-POLE TRANSMISSION LINE				IRON-POLE TRANSMISSION LINE			
	GROUND RETURN		METALLIC RETURN		GROUND RETURN		METALLIC RETURN	
	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses	Cost of Installation	Annual Expenses
Building for converter station	$54,000	$4,500	$54,000	$4,500	$54,000	$4,500	$54,000	$4,500
Generating equipment:								
Two 10,000-hp turbines	$81,000	$7,600	$81,000	$7,600	$81,000	$7,600	$81,000	$7,600
Two three-phase generators	70,300	6,600	70,300	6,600	70,300	6,600	70,300	6,600
Switchboard and switch gear:	10,800	1,100	10,800	1,100	10,800	1,100	10,800	1,100
Three-phase motors	62,200	5,900	62,200	5,900	62,200	5,900	62,200	5,900
Direct-current generators and auxiliaries	194,500	19,300	194,500	19,300	194,500	19,300	194,500	19,300
Switchboard and switch gear	8,100	800	8,100	800	8,100	800	8,100	800
Wages and supplies in power station	.....	3,200	.....	3,200	.....	3,200	.....	3,200
Wages and supplies in converter station	.....	3,200	.....	3,200	.....	3,200	.....	3,200
	$426,900	$47,700	$426,900	$47,700	$426,900	$47,700	$426,900	$47,700
Submarine cables:								
Two cables, each 3.4 miles, 150,000 circ. mils	$24,600	$5,400	$24,600	$5,400	$24,600	$5,400	$24,600	$5,400
Laying of cables	18,900		18,900		18,900		18,900	
	$43,500	$5,400	$43,500	$5,400	$43,500	$5,400	$43,500	$5,400
Transmission line:								
Poles, including erection	$125,000	$13,000	$204,000	$21,100	$178,300	$17,700	$261,000	$26,100
Insulators	31,900	3,200	28,400	2,800	32,600	3,200	28,400	2,800
Iron cable	17,800	2,500	17,800	2,500	17,800	2,500	17,800	2,500
Copper conductors	166,000	11,300	470,000	32,000	166,000	11,300	470,000	32,000
Linemen	.....	2,200	.....	2,200	.....	2,200	.....	2,200
	$340,700	$32,200	$720,200	$60,600	$394,700	$36,900	$777,200	$65,600
Incidentals	$174,500	$18,300	$240,500	$23,600	$188,500	$19,000	$263,000	$24,700
Total	$1,039,600	$108,100	$1,485,300	$141,800	$1,107,600	$113,500	$1,564,600	$148,100
Frequency-converter station:								
Direct-current motors and auxiliaries	$200,000	$19,800	$192,000	$19,000	$200,000	$19,800	$192,000	$19,000
Three-phase generators	46,000	4,300	43,200	4,100	46,000	4,300	43,200	4,100
Switchboard and switch gear	9,500	900	9,500	900	9,500	900	9,500	900
Wages and supplies	.....	3,200	.....	3,200	.....	3,200	.....	3,200
Incidentals	55,500	5,500	52,700	5,500	55,500	5,500	52,700	5,500
	$311,000	$33,700	$297,400	$32,700	$311,000	$33,700	$297,400	$32,700
Grand total	$1,350,600	$141,800	$1,782,700	$174,500	$1,418,600	$147,200	$1,862,000	$180,800

tors a constant current of 150 amp was proposed, which, with a total of 14,720 kw at the turbines and a maximum emf of 91,250 volts, could be obtained on twenty 4560-volt generators. The generators would be arranged in four groups, each having five generators in series, and each group would be connected to a 5000-hp turbine.

The efficiency of the direct-current generators and motors was assumed to be 93 per cent, that of alternating-current generators 96 per cent, and that of alternating-current motors 94 per cent. For transmission with ground return a 238,000-circ. mil conductor could be used, which, however, should preferably be divided up into two conductors each of 119,000-circ. mil cross-section. For the metallic-return system two 335,000-circ. mil conductors would be required. In case of emergency operation could be maintained on one wire with ground return, and on this account allowance was made for the same insulation of machinery in both the ground-return and the metallic-return systems.

The price of copper was figured at 21 cents a pound and insulators at $8 each, including cost of installation. The line losses in the ground-return system were estimated at 1075 kw and for a metallic-return system at 1520 kw. The use of iron poles of lattice-work construction was contemplated. The estimates of annual expenses for this system were based on the same rate of depreciation as given for the alternating-current system in Table IV, except that for the direct-current generating equipment and auxiliaries 2.5 per cent was allowed for maintenance, making the fixed annual expense 9.9 per cent. The maintenance of wooden poles was figured at 3 per cent with the total annual expense at 10.4 per cent.

In regard to the technical merits of the various proposed systems the engineers point out that high-tension alternating-current systems are now commonly used and the method of operation is well known. Three-phase alternating current is now generated and distributed at Trollhättan. By using this system the generating equipment would be more uniform and the employees would be familiar with the operation of the system. The advantages claimed for the direct-current system are: simplicity in operation of generating equipment and building of transmission lines, the tension of the latter corresponding to only 64,000 volts alternating current; elimination of trouble from voltage variations due to varying load (the current is automatically kept constant at the power stations); high-tension underground and submarine cables can be used wherever necessary; simple protection against lightning and other disturbances; a certain amount of reserve in the ground-return system by using two wires, of which one will be able to carry the load temporarily in case of emergency. The only apparent disadvantage of the direct-current system, it was pointed out, is that relatively little is known about the operation of the system.

Conclusion

The relative merits of a modern steam-power plant as compared with the proposed purchase of energy from Trollhättan and transmission to Copenhagen were not considered in the report. The figures showing the cost of production at such a plant were used in this connection primarily to show the value of energy at Copenhagen.

The summary of the total annual cost per kilowatt of the various methods proposed (Table VIII) shows that direct-current generation and transmission using wooden-pole line construction and ground return is the most economical and also possesses favorable operating features, so that that system was recommended for the proposed line. The total annual expenses for this system are estimated to be $6.75 per kw for direct-current or $11.16 per kw for 50-cycle alternating current, in the former case 12,615 kw being available for distribution and in the latter case 11,225 kw.

TABLE VIII—SUMMARY OF COST ESTIMATES FOR VARIOUS SYSTEMS OF TRANSMISSION FROM TROLLHÄTTAN TO COPENHAGEN

System of Generation and Transmission	WITHOUT FREQUENCY-CONVERTER STATION AT COPENHAGEN				WITH CONVERTER STATION AT COPENHAGEN FOR CHANGING TO 50 CYCLES			
	Kilowatts Available at Copenhagen	Total Cost of Installation	ANNUAL EXPENSES		Kilowatts Available at Copenhagen	Total Cost of Installation	ANNUAL EXPENSES	
			Total	Per Kw			Total	Per Kw
Generating and transmitting alternating current	11,600	$1,431,500	$144,300	$12.43	10,440	$1,593,000	$163,300	$15.66
Generating and transmitting direct current:								
Wooden-pole transmission line:								
Ground return	12,615	864,700	87,800	6.95	11,225	1,202,000	125,400	11.16
Metallic return	12,170	1,320,900	121,500	10.00	10,830	1,643,700	157,300	14.52
Iron-pole transmission line:								
Ground return	12,615	931,400	93,200	7.38	11,225	1,269,200	130,500	11.61
Metallic return	12,170	1,390,900	127,400	10.48	10,830	1,715,300	163,300	15.09
Generating alternating current and transmitting direct current:								
Wooden-pole transmission line:								
Ground return	11,280	1,039,600	108,100	9.61	10,040	1,350,600	141,800	14.12
Metallic return	10,830	1,485,300	141,800	13.07	9,640	1,782,700	174,500	18.10
Iron-pole transmission line:								
Ground return	11,280	1,107,600	113,500	10.09	10,040	1,418,600	147,200	14.68
Metallic return	10,830	1,564,600	148,100	13.68	9,640	1,862,000	180,800	18.75

A Rational Method of Showing Light Distribution

By Robert ffrench Pierce

Engineering in all its branches is presumed to be an art singularly free from the trammels of tradition. In practically every branch "efficiency"—in the broad application of the word—is the consideration of first importance. With an assiduity commendable in a better cause, in illuminating engineering we have split hairs enthusiastically regarding the efficiencies of light sources and lighting systems, yet have remained helplessly in the shackles of an antiquated and cumbersome system of units which mean nothing and cannot be made to mean anything except by transformation into an alternative and more logical system, and we have persisted in a method of graphical representation of light-distribution characteristics which interposes almost every conceivable difficulty in the way of calculation and is so utterly misleading as to defeat its own object.

It is difficult to explain our adherence to the term "candle-power" upon any other ground than a reverence for a tradition more or less intrenched by common usage. As ordinarily interpreted and applied, the candle-power—if it is a unit of anything—is a unit of quantity. Its most frequent use is in connection with the photometric or distribution curve, and here it represents nothing more or less than the results of certain measurements involving the comparison of equal quantities of light with reference to the relative

magnitude of the respective solid angles containing these equal quantities. Thus, in making a photometric measurement we gather upon opposite sides of the photometric disk equal quantities of light, and by calculating from the relative distances of the light sources from the disk the relative magnitudes of the solid angles containing these equal fluxes establish a proportionality between the respective quantities

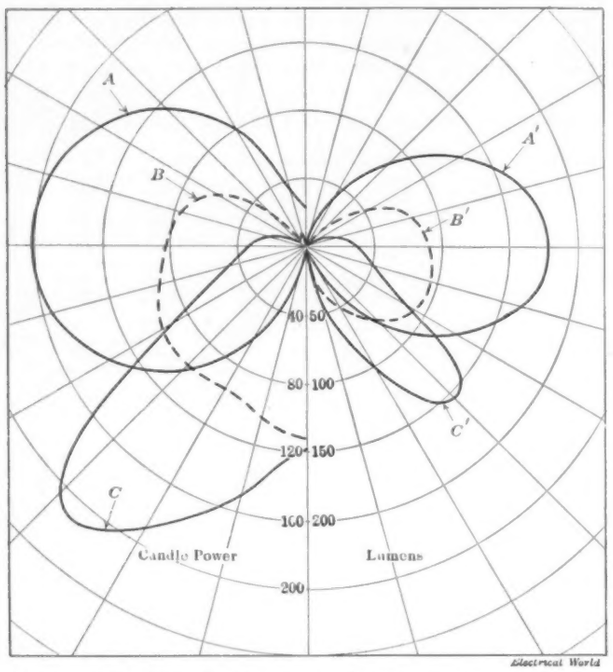


FIG. 1—PLANE AND SPACE DISTRIBUTION CURVES FROM UPRIGHT AND INVERTED GAS LAMP

of light emitted in equal solid angles by the light sources under comparison.

As used in this connection therefore—and this is by all odds the widest use of the term—the candle-power is a unit of quantity, yet it does not contain within itself any specification of quantity, nor can it be transformed in such a manner as to permit of quantitative calculations without resorting to a second unit (the lumen) which would have served every purpose of the candle-power in the first place. Why not, therefore, abandon the candle-power and substitute in its stead the lumen?

It may be argued that the lumen as at present defined is not easily reproducible for purposes of measurement or comparison. This is easily arranged by defining the lumen as ten times the quantity of light emitted in a solid angle of 1/100 steradians in a specified direction from a standard specified lamp consuming a specified quantity of pentane per hour under certain standard atmospheric conditions of humidity, CO^2 content, barometric pressure and temperature. This is a reproducible standard available for actual measurements. In plotting the results of such measurements in any form we shall have expressed the actual quantities measured—precisely what we should express.

It may be held by those who delight in analogies that the candle-power and the lumen are analogous to the unit magnet pole and unit magnetic field. This fact does not justify the use of the term candle-power in distribution curves, however, for results of magnetic-field explorations are not stated in terms of unit magnetic poles but in terms of unit magnetic field. There is moreover this further discrepancy—that no source of artificial light distributes light equally in all directions. Therefore, if the analogy is to be preserved, the "candle" or "candle-power" must be defined as a theoretical non-reproducible unit having such distribution characteristics and its specification derived from the definition of the lumen given above, or similarly.

It has been advanced in defense of the retention of the candle-power as the practical primary unit that primary units should be expressive of the quality or attribute through which the senses perceive the existence of the phenomenon involved, and that candle-power represents the luminous intensity by which the source is perceived. From this standpoint there is really still less excuse for retaining the candle-power as a working unit, for just as the strength of a magnet pole is perceived by the force it exerts through the magnetic field set up, so a light source is perceived through the flux of light received by the eye. Just as pole strength is non-existent at the point where magnetic force is perceived, so candle-power—using the term to designate light-producing power—is non-existent at the eye.

It is argued that luminosity—as perceived by the eye—is inherent in the light source, and that the relation between luminosity and light is not a causal one in a sense permitting their separation. This opinion is due to a loose and variable use of the term light. Light as a form of radiation is quite different from light as a physiological phenomenon. The latter conception is a subjective concomitant of the former. As far as our sense perceptions are concerned a light source may exist where there is no light, in evidence of which witness the image of a light source in a mirror. Thus light as a sense perception is an entirely different thing from light as radiation from a designated source, and it is utterly impossible to conceive, much less use, any unit referring to the source itself which shall be immanently connected with sense perception.

Thus the term candle-power—except as a pure abstraction—has no excuse for existence, scientific or practical, save that it is in common use. As for this consideration, it may safely be stated that as used at present it is chiefly valuable for conveying misinformation, or rather preventing and hampering the conveying of information. Any salesman of lighting appliances will testify to the innumerable occasions upon which he has been asked to state the

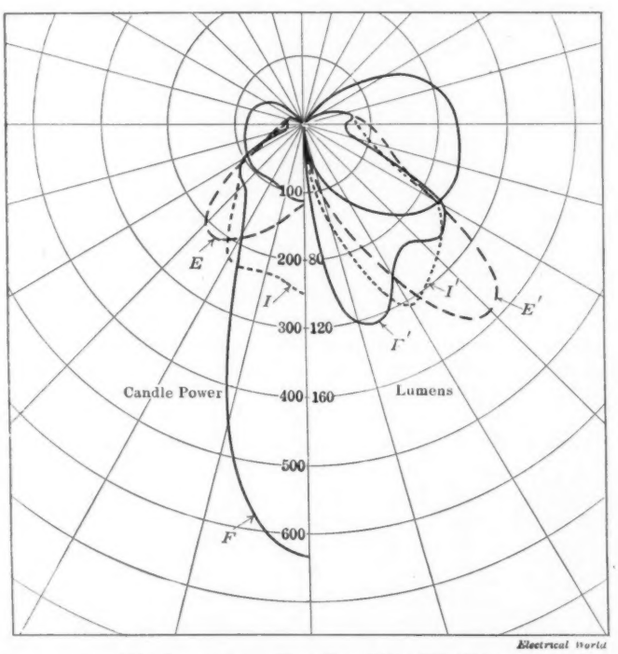


FIG. 2—DISTRIBUTION CURVES FROM INCANDESCENT GAS LAMP USING DIFFERENT TYPES OF REFLECTORS

candle-power of a lamp at 2 ft., at 10 ft., etc., and the almost invariable lack of success which attended his efforts to clear up the matter in the customer's mind.

Practically all the troubles encountered in conveying to the layman an idea of the characteristics of light sources are traceable to the illogical nature of the unit used. Where a unit is designated as being of 100 cp and an attempt is

made to explain how it may be caused to produce 5000 cp —in certain directions—by the use of reflectors it is small wonder that the layman is completely befuddled.

The "power" of the unit can refer only to its capability of transforming one form of energy into another and can take no account of distribution in space. As referring to the power of producing light localized at a given point in space, the candle-power is quite admissible and might be defined as the energy-transforming power of a point light source producing 12.57 lumens of light. The moment, however, that spatial relations or concepts are introduced it is absolutely necessary to use quantitative units. By the very nature of things, if the candle-power be not a unit of quantity it must express the radiating power of a point source, and a point source that does not radiate equally in all directions cannot be conceived. Therefore, the candle-power, which is based upon the performance of a point source, cannot possibly be made the unit for use in connection with a distribution curve except in the form of an "equivalent" or other awkward and useless expedient. To say that in one particular direction a 100-cp light source with reflector produces the same illumination as would be produced by a 5000-cp source—without a reflector—in the same position is a method so round-about and cumbersome as to be self-condemnatory, and the fact that the layman fails to "see" it is evidence of his logical mind.

In short, candle-power is an attribute of a light source having no relation to the distribution of light in space. To mean anything at all and to have practical value a unit by which light sources are to be measured must contain by definition the conception of quality and be capable of expressing flux density by the simple addition of the words "per square foot" or other unit area. The lumen fulfils this requirement admirably and perfectly, and there is no reason why it should not be used in every connection in which the candle-power is used at present.

In devising methods of using the lumen as the unit for the construction of distribution curves, the writer wished at the same time to eliminate the disadvantages of the present form of curves which make them perplexing and misleading not only to the layman but to the engineer as well. The chief purpose of any sort of curve—aside from those used as mechanical calculating devices—is the presentation of data in a graphical form, by which the eye may grasp at a glance the relation between two variables.

The ordinary distribution curve is not a complete statement of the distribution of light in space but simply a record of "samples"—so to speak—taken in a certain vertical plane and the quantity of light represented by each "sample" varies according to the angle at which it is taken.

Thus, before any adequate idea of the distribution of light in space may be obtained from this curve, it must be entirely transformed mentally, which robs it of all its graphical significance. On the right-hand side in Figs. 1 and 2 are shown curves designed to represent the distribution of light in space, in which the radial ordinates express the flux of light in a zone 10 deg. wide extending 5 deg. on either side of the designated angle. The width of this zone could of course be 1 deg., 2 deg. or any desired width. In Fig. 1 curves *A*, *B* and *C* are ordinary (or plane) distribution curves from respectively an upright incandescent gas lamp, an inverted incandescent gas lamp, and the latter with extensive prismatic reflector. Curves *A'*, *B'* and *C'* are space distribution curves of the same units in the same order. In Fig. 2 curves *E*, *I* and *F* are plane distribution curves of inverted incandescent-gas lamps with "extensive," "intensive" and "focusing" prismatic reflectors respectively, while curves *E'*, *I'* and *F'* show space distribution of the same units. Comparing *E* with *E'*, it will be seen that while the former suggests that most of the light is within 45 deg. from the vertical the latter shows that at last one-half the light from this unit is above 45 deg. Curve *I* conveys the impression that the light from this unit is fairly well concentrated within 30 deg. from the vertical, but curve *I'* shows that only about one-third the light is actually emitted in this zone.

According to curve *F* this unit delivers most of its light within 20 deg. from the vertical, while *F'* shows that about three-fourths the light is outside this zone.

These approximations are necessarily rough, for it is difficult to estimate the degree to which different individuals would mentally take into account the greater fluxes represented by a certain candle-power as the angle approaches 90 deg. in the plane-distribution curves. Furthermore, the fluxes in different zones in the space distribution curves are *not* proportional to the areas cut off by the angles representing these zones. To correct this latter discrepancy the method of construction shown in Fig. 3 was devised. Here the lengths of the radial ordinates are proportional to the square roots of the quantities represented and the areas cut off by angles bounding certain zones are proportional to the fluxes in these zones.

Curves constructed in this manner may be used for point-by-point calculations with the same facility as the plane distribution curve plotted to candle-power simply by using

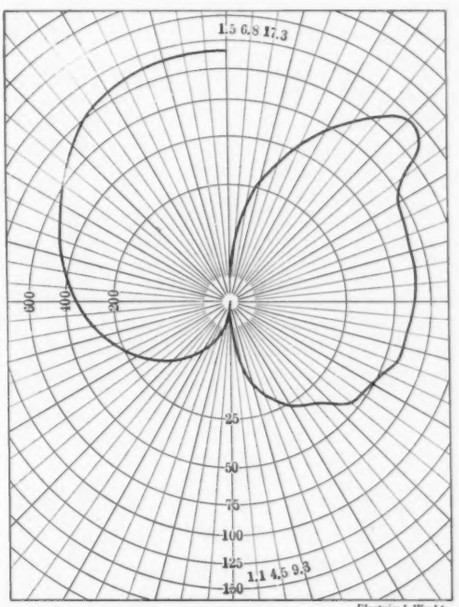


FIG. 3—NEW TYPE OF DISTRIBUTION CURVE

another set of constants. In the space distribution curve the ordinates at and near 0 deg. and 180 deg. are too small to read from the curve and the numerical values at 0 deg., 5 deg., 10 deg., 170 deg., 175 deg. and 180 deg. are given on the angles designated as shown in Fig. 3.

It may be objected that this form of curve is extremely misleading in that practically no light flux is indicated directly below the lamp even with a focusing reflector. This feature, however, being a characteristic of all curves plotted in this form, the low values at the angles mentioned will be expected by the engineer and convey no misapprehension. At the left hand in Fig. 3 is shown a summation curve of the values on the right-hand side. At any angle this curve gives the total flux up to the angle designated. Zonular fluxes in any zone, from 0 deg. upward, lower hemispherical and spherical fluxes may thus be read directly from the curve and upper hemispherical flux, and flux in the zone between any two angles may be obtained by one subtraction or obtained from the right-hand curve by planimeter.

The curves in Fig. 3 appear to the writer to convey all the data required by the engineer in a graphical and usable form to a far greater extent than any other form yet devised, and he has accordingly decided to adopt them as the basis of engineering calculations and photometric records.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Central-Station "Safety First" Watch-Fobs

As a reminder of the company's paramount instruction to its employees, "Safety First!" the West Penn Electric Company, of Connellsville, Pa., has presented each of its employees with a watch-fob bearing this legend. The fobs are being worn with evident pride by the men of the company, who take especial care to see that the safety precept is in a conspicuous position. Besides being handsome and serviceable as ornaments, the new fobs serve to identify employees of the organization and so strengthen the *esprit de corps*.

System Factors of Southern California Company

During 1912 the Southern California Edison Company, which operates in Los Angeles and vicinity, constructed fourteen substations, built 80 miles of transmission lines and installed a 15,000-kw turbine unit at Long Beach, where it has a third machine under way. The system load-factor for the year was 60.5 per cent, against 52.4 per cent for 1911. Industrial motor service contracts were signed amounting to 26,923 hp, compared with 16,876 hp for the year before, and the appliance sales numbered 23,148. Forty-seven new automobiles were added to the company's equipment, making a total of seventy-eight. In addition to the 80 miles of transmission lines above mentioned, several hundred miles of low-tension distributing circuits were constructed during the year recently closed.

Appliance Sales at Oklahoma City

During the last eight months of 1912 1328 electric appliances were sold in Oklahoma City, according to the estimate of Mr. R. C. Leonard, contract agent for the Oklahoma Gas & Electric Company. No records were kept prior to May, but the report as submitted includes 675 flatirons, 190 fans, 150 toasters, 94 grills and 45 percolators. The 1328 appliances represent a total load of 529 kw, which at accepted figures means an annual revenue to the company of nearly $7,500. Mr. Leonard estimates that this result was secured with an expense of only $663, for newspaper advertising in excess of regular space.

Central-Station Service in Flood Times

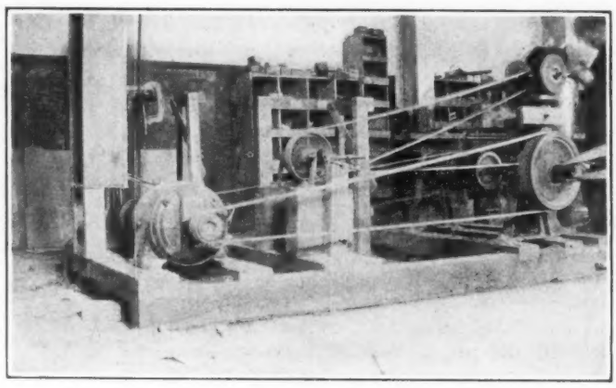
The crest of the Ohio River flood of this season reached an elevation of nearly 40 ft. at Louisville, Ky., the highest rise on record there since the memorable flood of 1884. An incident of the recent rise was the shutting down of a number of isolated power plants in the manufacturing district of the Kentucky city's river front. The water went over the cut-off protecting the lower section of the town and filled many private boiler rooms and engine rooms to a depth of from 8 ft. to 10 ft.

Among the factories in the flooded district was that of the Louisville Veneer Mills, which had been recently equipped with central-station service from the lines of the Louisville Lighting Company. Despite the flood, which paralyzed manufacturing everywhere about, the veneer works were shut down barely twenty-four hours, being able to resume regular operation though islanded by the overflow, according to Mr. A. T. Macdonald, sales manager for the Louisville company.

The Louisville Veneer Mills now has a connected load of 400 hp and heats all its glue (of which it consumes about $600 worth each month) by electricity. "We have been especially delighted with electric service," said Mr. Harry E. Kline, of the company, "and in flood times it is the greatest ever!"

A Portable Motor-Driven Shop

The convenience of electricity in construction work is well illustrated in the accompanying illustration of a temporary machine shop assembled by a contracting firm in an electric-railway substation at Brookline, Mass. The shop was set up in the basement of the uncompleted building, a 5-hp motor and some pulleys being mounted on a timber frame and connected to drive a grinder, a hack-saw and other small tools. These proved most useful in expediting



PORTABLE MOTOR-DRIVEN SHOP

the work of installing switchboard angle-irons, bus structures and wiring. Energy was supplied from a 550-volt feeder circuit in the vicinity, and the installation proved to be a positive factor in saving time during the erection of the substaton and the adjustment of its equipment. The building was located in a high-class residential district, and the absence of noise and dirt was much appreciated.

Co-operation in Minneapolis

The Minneapolis General Electric Company gave a dinner on Jan. 16 to the electrical contractors and supply men of that city at which 115 guests were present. The object of the meeting was to create a better understanding between the electric-service company and the other electrical interests of the city. The city wiring inspector and the city underground inspector were both present and gave short talks. During the evening a committee was selected by vote of those present to act with the electric-service company in various ways for better co-operation between the electrical interests of the city.

Power for Adzing and Boring Railroad Ties

In a paper on "Adzing and Boring Ties," read by Mr. James A. Lounsbury, of Chicago, before the recent convention of the American Wood Preservers' Association, the author contended that it is folly to pay 20 to 35 cents a tie for wood preservation and then to mutilate the ties by hand-adzing and spike-driving, reducing greatly the beneficial effects of treatment. Naturally, the adzing and boring should be done before the treatment is applied. Adzing and boring machines are of two types—permanent and portable. Referring to the latter, Mr. Lounsbury said: "The kind of power to be used in these movable plants is often a somewhat troublesome problem. Electric drive is by far the most reliable and satisfactory if it is available. In yards using electric switching locomotives and strung with trolley wires the application of electric power is easy, but where this is not to be had resort must be made to some other source of power, usually a self-contained gasoline engine of about 60 hp installed in the car with the machine. This gives satisfactory results but requires more careful management than would be necessary with an electric motor."

Ton-Mile Electric Delivery Costs

The following data bearing on the comparative cost of ton-mile haulage by horses and electric vehicles were obtained by a prominent electric-truck manufacturer from installations in New York City. The 1500-lb. delivery service cited was that of a large department store; the 2-ton service included general-merchandise delivery, usually in units of medium size, and the third class, 5 tons, covered the delivery of large cases of similar material over a wide area. The figures given in the table include the stabling of the horses required to haul a truck of the stated size.

CLASSIFICATION OF SERVICES

	1500-LB.		TWO TONS		FIVE TONS	
	Horses	Electric	Horses	Electric	Horses	Electric
Miles per day.....	17	30	16	30	12	24
Ton-miles per day..	12.75	22.50	32	60	60	120
Cost per day.....	$6.00	$6.00	$6.37	$8.50	$9.10	$11.00
Cost per mile.....	0.35	0.20	0.52	0.28	0.76	0.45
Ton-mile cost.....	0.466	0.207	0.26	0.14	0.15	0.09

These figures bear out the contention that the electric truck gives a greater service and at a lower cost than is possible with horse-drawn equipment. The figures represent practically the limit of the horse, but they do not indicate the maximum possibilities of the electric truck, the mileage of which often runs considerably higher than in the figures presented. The data above given include all expenses and charges, with energy at 4 cents per kw-hr.; chauffeur's wages at $15 per week; writing off the investment in eight years; payment of 6 per cent interest meanwhile, with insurance and taxes, and one renewal of battery plates and tires yearly.

The Electric Truck as a Source of Income to the Central Station

The figures recently brought out by Mr. H. W. Hillman in a paper before the Electric Vehicle Association of America on the relative importance of the electric truck and other classes of central-station business (reported on page 179 of the *Electrical World* of Jan. 25) contain much food for thought for the central-station manager. Many plants, even in the smaller cities, have sales organizations whose sole duty it is to popularize and sell heating and cooking appliances. Others have departments devoted to building up industrial-motor day load, while still others are inaugurating and carrying out extensive house-wiring campaigns.

Strong and convincing argument for an electric-vehicle

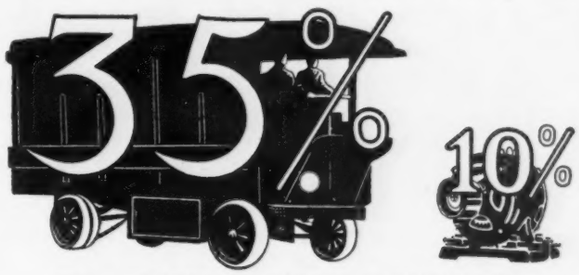


FIG. 1—GRAPHIC COMPARISON OF LOAD-FACTORS

department, as well, in every progressive central station is presented by the fact that it requires eighty-six flatirons to produce an annual income equal to that from one 2-ton truck. The load-factor of the commercial electric vehicle is 35 per cent and that of the industrial motor is 10 per cent. Twenty-seven houses wired and added to the central-station lines would be required to produce an annual income equal to that from one truck of average size.

Of the twelve classes of service furnished by the central station only two return a higher income than is derived from one 2-ton truck. Figures compiled from thirty cities whose population varies from less than 25,000 to more than 1,000,000 show the saloon to be at the head of the list, with an average annual return of $191.51. Next is the drug store, with $118.40. Then comes the 2-ton truck, with a revenue of $86.00. Then follow, in order, large residences, with $63.04; industrial plants, with twenty motors, $35.11; eight-motor installations, $50.96; small factories with three motors, $19.61; plants with two motors, $41.18; single-

FIG. 2—RELATIVE ANNUAL INCOME FROM DIFFERENT CLASSES OF CONNECTED LOAD

motor installations, $43.16; churches, $32.57; retail stores, $31.75, and the small residence is last, with $15.22.

The "off-peak" character of the load furnished by the truck, combined with the fact that the electric-truck owner is a long-hour consumer who will help fill up the costly depressions and deep hollows in the load curve, should stimulate an aggressive sales policy in this direction on the part of central-station commercial managers.

How Weather Conditions Affect Electric-Light Bills

Customers of electric-service companies often fail to understand the vital and immediate effect of meteorological conditions on their monthly bills for lighting. To explain this graphically several companies have issued charts showing the artificial-lighting periods during the various months of the year. One chart of this description, used by the lighting department of the Kokomo, Marion & Western Traction Company, was illustrated in the *Electrical World* of Sept. 7, page 512.

Considerable study has been given to this subject recently by various departments of the Commonwealth Edison Company of Chicago. One plan adopted to make the conditions clear to the public is shown in the chart in the newspaper advertisement reproduced in fac-simile herewith (Fig. 1). In this case the horizontal-line method is used, these lines (one for each month) being divided into unequal portions showing the daylight period, from noon until dusk; the artificial lighting period, from dusk until 10 p. m.; the sleeping period, reckoned from 10 p. m. to 6 a. m., and the period from sunrise to noon, principally daylight but also containing an artificial lighting period in the winter months, as shown in the chart. This form shows that in Chicago the average use of electric light in residences in June is 2.55 hours a day, whereas in December the corresponding figure is 6.85 hours a day. The average use of electric light in the home is therefore nearly three times as great in December as in June.

At the request of the claim department, which wished an explanatory diagram to serve as a wall chart for the benefit of customers, the statistical department of the Commonwealth Edison Company has arranged another graphical

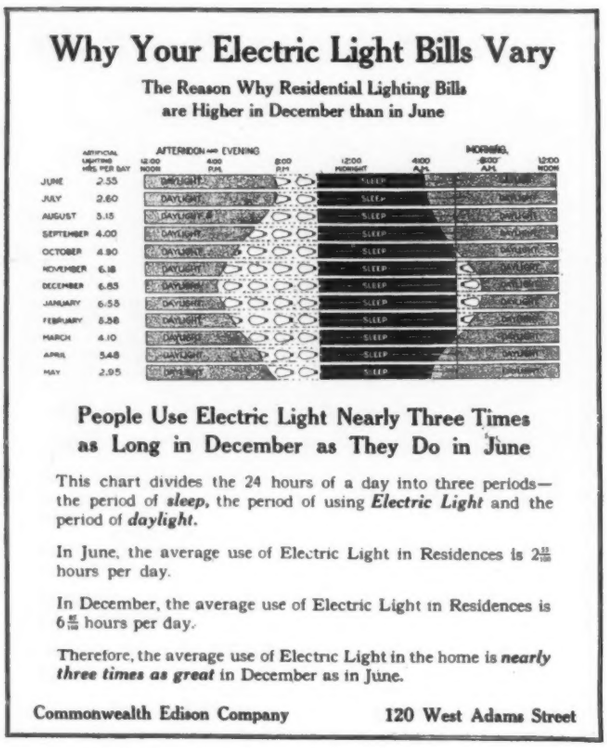

Why Your Electric Light Bills Vary
The Reason Why Residential Lighting Bills are Higher in December than in June
ARTIFICIAL LIGHTING HRS. PER DAY
AFTERNOON AND EVENING
MORNING
JUNE 2.55
JULY 2.60
AUGUST 3.15
SEPTEMBER 4.00
OCTOBER 4.90
NOVEMBER 6.18
DECEMBER 6.85
JANUARY 6.55
FEBRUARY 5.58
MARCH 4.10
APRIL 3.48
MAY 2.95
DAYLIGHT
SLEEP
People Use Electric Light Nearly Three Times as Long in December as They Do in June
This chart divides the 24 hours of a day into three periods—the period of sleep, the period of using Electric Light and the period of daylight.
In June, the average use of Electric Light in Residences is 2 55/100 hours per day.
In December, the average use of Electric Light in Residences is 6 85/100 hours per day.
Therefore, the average use of Electric Light in the home is nearly three times as great in December as in June.
Commonwealth Edison Company
120 West Adams Street

FIG. 1—REPRODUCTION OF AN "AD" FROM A CHICAGO NEWSPAPER

representation, as shown in Fig. 2. In this case clock-dial diagrams are used, the smaller ones for individual months and the larger one showing the average for the whole year. These diagrams are the result of considerable work and are thought to set forth the situation with a close approximation to accuracy. It is to be remembered that not only are the actual daylight and darkness periods to be taken into account but also the effect of cloudiness. The percentage of normal sunshine for each month is shown by the figure just outside of each of the clock-dial diagrams.

It will be observed that the artificial lighting period in the latitude of Chicago is of shortest duration in the month of June, being but 10.7 per cent of the twenty-four hours. It is longest in December, being 28.6 per cent. For the

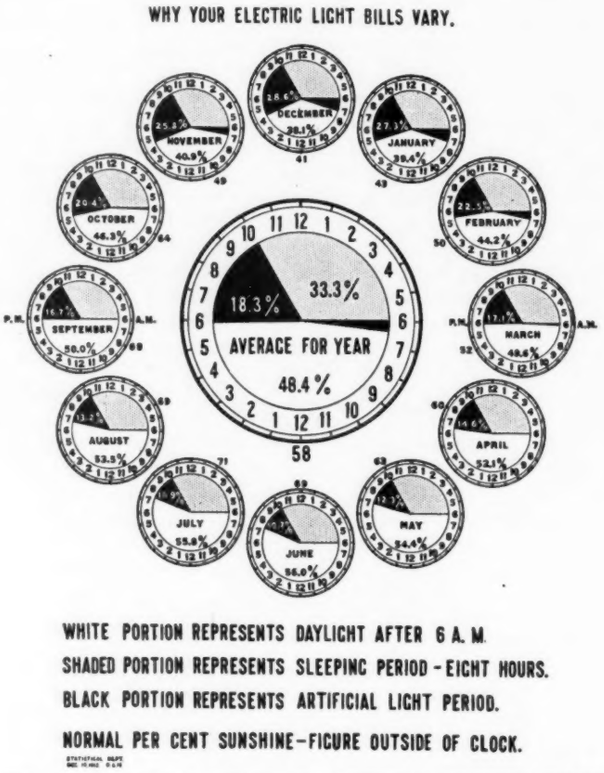


FIG. 2—CLOCK-DIAL CHART OF ARTIFICIAL-LIGHTING PERIOD

whole year the average of the artificial-lighting period is 18.3 per cent. The sleeping period for all months is constant at eight hours, or 33⅓ per cent. It is considered to be from 10 p. m. to 6 a. m., and the daylight period is computed after 6 a. m., ending at sunset. The average daylight period for the whole year is a little less than twelve hours.

Similar charts have been prepared by the Louisville Lighting Company. The chart for each month comprises a circle on which segments show the periods designated as "night," "sunshine," "cloudiness" and "very dark." The October, 1912, chart shows the night segment to be 53.3 per cent; "very dark," 4.6 per cent; cloudy, 12.9 per cent; sunshine, 29.2 per cent. In that month there were in Louisville fourteen clear days, eleven partly cloudy days, six cloudy days and two days with dense fog. The average sunshine per day for that month in Louisville is given as seven hours. The Louisville charts are records made up from United States Weather Bureau's reports, while the Chicago chart is made from a long series of observations.

Electricity in a Pillow Factory

The Louisville Pillow Company, of Louisville, Ky., manufacturer of bedding materials, has found central-station electric service to be eminently satisfactory in the operation of the varied equipment which it uses and which must be run at different speeds and under different conditions. It has just purchased four 35-hp alternating-current three-phase motors from the General Electric Company for the operation of ragpickers used in its shoddy factory. The Louisville Lighting Company is furnishing the service.

Illumination and Wiring

Symbolic Lighting Fixtures in Chicago Telephone Building

In the handsome new Bell Telephone Building at 212-226 West Washington Street, Chicago, there are some interesting symbolic lighting fixtures and allegorical designs. This building is twenty stories high and is said to be the largest telephone building in the world. It is occupied by the main offices of the Chicago Telephone Company and also contains the executive offices of the Wisconsin, Central Union, Cleveland and Michigan State telephone companies. These companies constitute the "Sunny group" of Bell telephone companies, Mr. B. E. Sunny being president of all of them. The building has a frontage of 141 ft. on Washington Street and extends back 181 ft. to an alley. It contains 4,600,000 cu. ft. of space.

FIG. 1—BELL LIGHTING FIXTURE

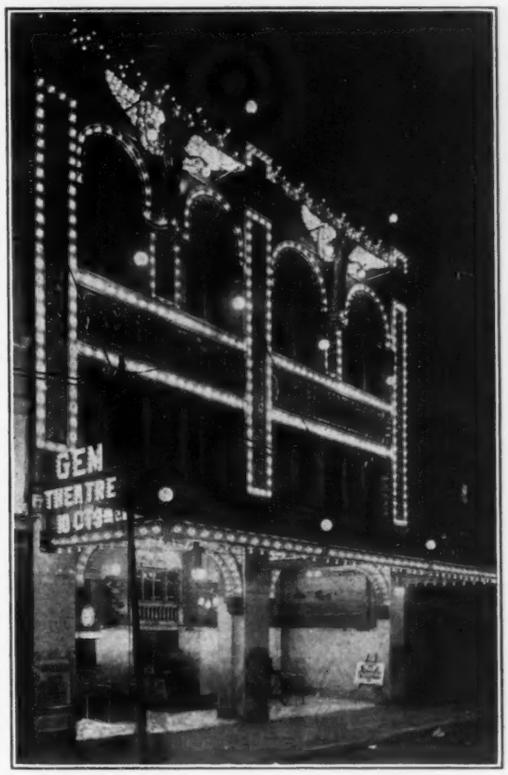
Fig. 1 shows the large overhead lighting fixture in the main entrance lobby. It is in the shape of the familiar blue bell of the Bell telephone companies. At present this lighting fixture is equipped with twenty-four 25-watt tungsten lamps. Later these may be replaced by twenty-four 100-watt lamps. A single frosted lamp is used to represent the clapper of the bell. Fig. 2 depicts one of the allegorical designs in relief over the main entrance. It will be noted that the same motif is carried out throughout the fixture ornamentation.

Electricity for the lighting and motor requirements of the building is purchased from the Commonwealth Edison Company. Each distributing panel from the third to the twentieth story inclusive is equipped for the installation of sixteen meters. General illumination is obtained from single-unit tungsten lamps. These are placed on centers of approximately 10 ft. and are designed so that the expenditure of power for lighting will be about 1 watt per square foot of floor space. Nine electric elevators are provided in the building.

FIG. 2—ALLEGORICAL DESIGN AT ENTRANCE OF CHICAGO TELEPHONE BUILDING

Theater-Front Illumination with Tungsten Lamps

The elaborate and attractive lighting of the Gem vaudeville theater, St. Louis, is shown in the accompanying illustration. This theater front is studded with nearly 2000 tungsten lamps, which outline the windows, panels and classic frieze designs. By an arrangement of flashers the winged figures at the top of the display appear to be in flight, lending an attractive touch of motion to the otherwise uninterrupted operation of the main decorative units. The Gem Theater is directly across the street from and under the same management as the Hippodrome, concerning which an illustrated account was given in the *Electrical World* of Dec. 7, 1912, page 1214. This article described the 380-contact flasher mechanism which controls the 9000 lamps studding the Hippodrome façade.



ILLUMINATION OF THEATER FRONT

Present Status of Grounded Secondaries

As a matter of safety, theory apparently indicates the necessity of thorough grounding, said Mr. W. J. Canada, engineer for the Rocky Mountain Fire Underwriters' Association, Denver, Col., in his address on present practices in grounding secondaries, delivered before the Western Association of Electrical Inspectors at St. Louis Jan. 29.

One naturally turns to practice, however, to support theory or to locate its flaws, for the engineering judgment of observing operators must have considerable weight in any investigation. To obtain such consensus of practice 140 service companies, representing every state and the Dominion of Canada, were written to, a series of questions being inclosed, and one hundred or more replies were received. The accompanying recapitulation shows general satisfaction in all sections following adoption of grounding. Of the forty-five companies grounding in the Rocky Mountain field, only eleven are included in this list.

That many companies recognize the ungrounded secondary as a fire and life hazard is proved by their own statements of experience with injuries and fires from high voltage on their secondaries, said Mr. Canada, who went on to state that of forty-nine cities from which deaths were reported forty-one are now partly or entirely grounded. That

some companies not grounding see no necessity for change seems to show an unprogressive policy and appears too much like "waiting for the horse to be stolen." But as one service company manager writes: "It depends on your own experience with injuries and fires from high voltage how strongly you feel on the subject. If you have been lucky enough to escape, you are not inclined to see the advantages of grounding so clearly."

RECAPITULATION OF DATA ON GROUNDING

1.	Companies using grounding	86, or 87 per cent
	Companies not grounding	13, or 13 per cent
2.	Expressing belief in grounding	92, or 96 per cent
	Expressing disbelief in grounding	4, or 4 per cent
3.	Experience with grounding, one to twenty-five years, average, five years	
4.	Companies reporting advantages in grounding	69, or 85 per cent
	Companies reporting disadvantages in grounding	12, or 15 per cent
5.	Total number advantages mentioned	171, or 89 per cent
	Total number disadvantages mentioned	21, or 11 per cent
6.	Companies uncertain whether advantageous or not	8, or 9 per cent
7.	Expense of one ground, $0.50 to $15, average	$3.50
8.	Companies grounding above 110 volts	6
9.	Companies' experience with grounding "good"	86, or 99 per cent
	Companies' experience with grounding not "good"	1, or 1 per cent
10.	Companies' experience shows life hazard reduced	84, or 98 per cent
	Companies' experience shows life hazard not reduced	2, or 2 per cent
11.	Companies' experience shows fire hazard reduced	64, or 84 per cent
	Companies' experience shows fire hazard not reduced	2, or 3 per cent
	Companies' experience shows no preference	11, or 13 per cent
12.	Companies' experience shows operating conditions bettered	63, or 76 per cent
	Companies' experience shows operating conditions worse	9, or 11 per cent
	Companies' experience shows operating conditions same	11, or 13 per cent
13.	Companies utilizing mains	34, or 31 per cent
	Companies utilizing driven pipes	52, or 48 per cent
	Companies utilizing cones	6, or 6 per cent
	Companies utilizing plates	13, or 12 per cent
	Companies utilizing tracks	3, or 3 per cent
14.	Companies which prefer water mains	71, or 92 per cent
	Companies which prefer other methods	6, or 8 per cent
15.	Companies interconnecting secondaries	33, or 49 per cent
	Companies not interconnecting secondaries	34, or 51 per cent
16.	Companies grounding within buildings	17, or 28 per cent
	Companies not grounding within buildings	43, or 72 per cent
17.	Companies finding current shunted into buildings over ground connection	4, or 6 per cent
	Companies not finding current shunted into buildings over ground connection	62, or 94 per cent

Re-equipment of a Pittsburgh Department Store

The large fourteen-story department store of McCreery & Company, Pittsburgh, Pa., was recently re-equipped with a new and modern lighting installation, the result being a marked improvement in the quality of illumination secured, in addition to a saving of over 50 per cent effected at the same time in the cost of operation. In a paper read before the Pittsburgh Section of the Illuminating Engineering Society on Jan. 24 Mr. H. W. Shalling described the changes made in the McCreery equipment and presented data of tests made under the new lighting.

In general the work consisted of substituting tungsten lamps for the existing arc lamps and carbon-incandescent units, with practically no changes in the wiring. The task of substitution was completed floor by floor, in a single night, so that when the sales force arrived next morning a complete new lighting installation was found in service, without the dirt and annoyance usual with such changes.

Direct illumination was decided upon for general use, glass being avoided by inclosing the bowl-frosted lamps, where necessary, in opal or diffusing glassware. The quality of tungsten illumination was considered desirable both on account of its close approximation to daylight and the fact that many of the fabrics sold in the store are used chiefly under equivalent artificial lighting in the home, at the theater, etc.

The McCreery building is fourteen stories high, including the basement and the attic. The ground floor covers a space 100 ft. by 216 ft. and each of the remaining floors 90 ft. by 216 ft. The inside area of the first floor is approximately 20,370 sq. ft., and that of the remaining floors 17,850 sq. ft. The outside of the building is finished in white terra-cotta; the interior, including the fixtures, is in mahogany.

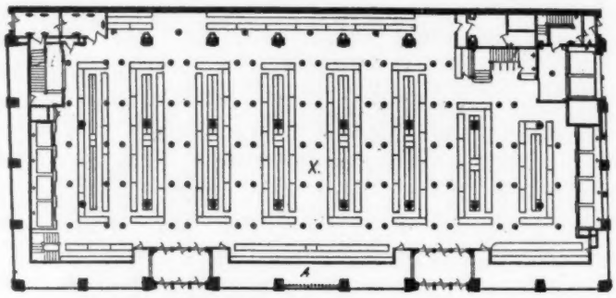

X
A
A – Typical section of show windows showing location of Light Units.
● Indicates location of Columns.
◉ Indicates location of Light Units.
X – Indicates bay in which Illumination Readings were taken.

FIG. 1—LIGHTING ARRANGEMENT OF FIRST FLOOR

Lighting by Floors

In the basement delivery room carbon clusters were replaced by eighteen 60-watt clear tungsten lamps in enameled steel reflectors.

On the main floor (men's furnishings, jewelry, stationery, trimmings, etc.) the ornamental arc and incandescent fixtures were adapted to reflector-ball units of special design, with upper prismatic reflectors resting on stalactite-shaped blown globes, the whole satin-finished. By varying the lamp position, extensive, intensive and focusing distributions could be obtained, the intensive being adopted. Each of the sixteen 5-amp arc lamps was replaced by a 250-watt clear tungsten unit. The five four-lamp pillar brackets and the thirty-four two-lamp fixtures were replaced by 25-watt tungsten lamps in decorative shades.

For the second floor, where bedding and yard goods are sold, the equipment formerly consisted of fifty-three 5-amp inclosed-arc lamps, with opal outer globes. Fairly high illumination is required here for matching dress goods. Each arc lamp was replaced by a 400-watt clear tungsten lamp placed inside a 14-in. two-piece diffusing glass bowl.

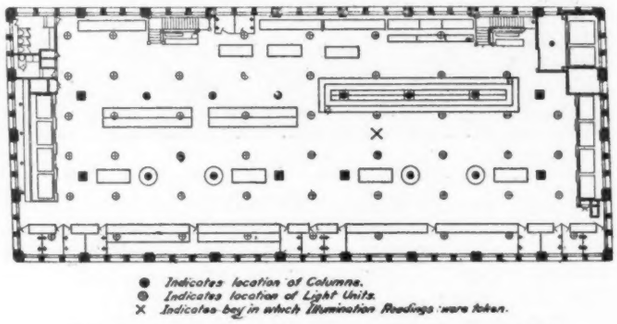

● Indicates location of Columns.
◉ Indicates location of Light Units.
× Indicates bay in which Illumination Readings were taken.

FIG. 2—TYPICAL ARRANGEMENT ON UPPER FLOORS

The unit consists of a clear stiletto-prism reflector mounted over a satin bowl, in a verde-antique fixture.

On the third floor, where ladies' suits, waists and furs are sold, fifty-one arc lamps were replaced by 250-watt tungsten lamps, and in the side brackets 25-watt tungsten lamps were substituted for 16-cp carbon lamps.

In the millinery department on the fourth floor, twelve arc lamps were replaced by 150-watt clear tungsten lamps in

semi-indirect fixtures of Louis XIV. ornamental design to conform with the room. The rest of the floor is lighted by thirty-three 250-watt units like those on the third story.

Of the fifty arc lamps on the fifth floor, where china, bric-à-brac and rugs are sold, twenty-five were replaced by 150-watt units and twenty-five by 250-watt clear tungsten lamps.

Special Rug-Rack Illumination

A special form of lighting was installed for the rug rack. Twenty-five outlets were provided on the circumference of a semicircle, the radius of which was approximately 2 ft. greater than the maximum swing of the rack arms. Outlets were located at centers 2 ft. 6 in. apart. Wiring was run in metal molding and small porcelain receptacles having a metallic head for use with shade holder were used. Each outlet was equipped with one 40-watt clear tungsten lamp and a 30-deg. angle-steel reflector having an aluminumized interior surface mounted on the ceiling in a pendent position.

Mission furniture, wall paper, draperies, art goods and the ladies' parlor occupy the sixth floor. For the general illumination thirty arc lamps were replaced by tungsten units as on the third.

Forty-five arc lamps formerly lighted the men's clothing department on the seventh floor, where also are located the general offices. Of these thirty-six were replaced by 400-watt and nine by 250-watt clear tungsten units. A high intensity is needed here, as on the second floor, on account of the dark colors of the goods displayed.

The installations already cited exemplify the general practice followed on the remaining floors, except in the dining-room, where 30-watt carbon lamps in seventy-one six-lamp clusters were replaced by 15-watt tungsten units.

Show-Window Equipment

In average size the show windows measure 23 ft. 6 in. long, 8 ft. deep and 19 ft. high, the plate glass extending to a height of 12 ft. and prism glass being used at the top.

The former equipment consisted of 326 60-watt clear carbon lamps mounted in a mirrored trough back of the transom bar. The present equipment consists of 195 60-watt clear tungsten lamps. Fifteen are used in each section, the outlets being located back of the transom bar on centers approximately 14 in. apart. Each lamp is equipped with a 100-watt-size concentrating-type prismatic reflector, the units being mounted at an angle so that the tip of the lamp is pointing at a line on the floor two-thirds of the distance from the plate glass to the opposite wall. This angle is found best for the average window dress, but provision is also made for varying the angle. The wattage allowance for the windows is but 4.7 per square foot.

Comparative tests made in similar positions on similar floors using the former arc and incandescent lighting and the new tungsten installation showed 50 to 100 per cent better illumination with the new improved lighting.

Inspection and Cleaning

A careful system for regular inspection and cleaning has been initiated whereby all units in the McCreery building are brushed off with a stiff brush and cloth once every two weeks, and each unit is taken down and washed thoroughly once each month. The cost of cleaning, including labor and materials, is approximately $350 per year for approximately 1000 units installed. Since the units are thoroughly cleaned once a month, the cost of cleaning per unit will be approximately 3 cents, which includes one dusting and one washing. A fair division of this cost would be 0.05 cent per unit for dusting and 2.5 cents for thorough cleaning. Under such a system the illuminating efficiency is kept at a practical maximum. It is probable, however, that in other places where dirt and dust conditions are not as severe the cleaning could be done at less frequent intervals. The above-given figures represent a very small part of the operating expense and are considerably less than the cost of trimming and other maintenance charges incident to the operation of the old system.

Recent Telephone Patents

Composite System

A composite system forms the subject of a patent granted to Mr. O. T. Lademan, of Milwaukee. In this system the telegraph keys, telegraph relays and telephone instruments are all in series relation to the line. The telegraph relays are shunted by high-capacity condensers and the telegraph keys by low-capacity condensers. The telephone instruments are of special make and are provided with an adjustable repeating coil for controlling the inductive relation between the receiver circuit and the line, with a view to reducing a Morse disturbance. High-frequency vibrators and buzzers are provided for telephone signaling. The transmitter circuit must be manually switched from receiving to transmitting position. This patent is assigned to the Railroad Telephone & Electric Company.

Miscellaneous Appliances

A patent granted to Mr. I. D. Fellows, of Syracuse, N. Y., relates to an emergency signaling system. According to this arrangement, an emergency signal may be sent to the Central Office without access to the telephone instrument. To this end push buttons are arranged at suitable places which release a sender akin to a messenger call box. The signals are continuously repeated, however, until answered so that the central-office operator may discover their nature and send the proper assistance. Such an arrangement is suggested where, in the case of emergency, the telephone may have been purposely disabled or access to it is impracticable.

Letters to the Editors

Central-Station Consolidation

To the Editors of the Electrical World:

SIRS:—In connection with recent discussions in your journal regarding central-station consolidation, you may be interested in some views which are perhaps more representative of the banker's standpoint than anything you have so far published on the subject. From this standpoint—that of the banking house buying mortgage bonds—the holding company has material disadvantages. It has been the experience of such bankers that in very few instances have utilities under holding-company control made proper provision for the complete present and future maintenance of their physical properties. I can recall the case of one holding company which was reported to be showing 10 per cent on its common stock. This stock happened to be very nearly equal in amount to the combined annual gross earnings of its subsidiary companies. The stock sold at a price in excess of par and a dividend of 6 per cent was being paid on it. If 10 per cent of the gross earnings were deducted for depreciation, there would have been nothing available for dividends on the common stock, and the market value would no doubt have been less than par. These and other facts afford ground for some concern as to where "high finance" is going to lead in the public-utility business. It may, unfortunately, lead to drastic legislation which will fall alike on the just and the unjust. Such doubts as these are worth more consideration than the views of those who are devoting most of their energies to making money while the sun shines but who do not make the ultimate good of the industry a prime consideration in their operations.

Philadelphia, Pa. A. E. ROSENBERGER.

Commercial Training for Engineers

To the Editors of the Electrical World:

SIRS:—Economic engineering, sometimes called commercial engineering, is a combination of good business management and technical knowledge correctly applied. Large corporations as well as smaller business interests have come to realize the necessity of such a combination, and for that reason a few of the technical schools of the country are giving it the attention it should receive. The chief fault to be found in the engineering instruction given by most of our technical schools has been the laying of too much stress on theory and abstract matters, with too little attention to the practical and concrete phases of the profession. The great manufacturing and producing interests must have high-grade engineers, men who are capable of harnessing and utilizing the forces and materials of nature, but their crying need to-day is for the man who can do more than this. They demand men who can dispose of their product after it has been made marketable by the inventive genius of the creative engineer.

In the complex commercial world of the present there exists a great amount of competition. No matter how good a product may be or how useful and efficient it is, if it cannot be marketed it might just as well have never been produced. Hundreds of devices which were the result of hard and long years of labor on the part of the struggling inventor are still of no use to the world simply because the inventor or owner is without the sales ability or business knowledge to market them. Yet the engineering schools of the country persist in ignoring this state of affairs and continue to grind out mechanical, civil, electrical and chemical engineers by the thousand, and then wonder why many graduates are not more successful.

There is a reason for this condition, and it is not the lack of ambition or ability in the individual in most cases. It is simply due to the fact that these men failed to receive the proper training. They were loaded down with formulas, laws, methods of computation, etc., yet they did not learn the first principle of salesmanship, a single fundamental method of business, or an elementary knowledge of advertising. These things are of vast and growing importance, particularly in the commercial electrical field, but they have been completely and persistently ignored. While there are undoubtedly many positions which require the talent of the pure engineer, these are in the small minority, and the very fact that they are so few renders the competition extremely keen because of the rapidly increasing number of candidates, all graduates of technical schools. The condition which has just been described is certainly abnormal and should be remedied without delay.

The solution is simple. An engineer should be equipped with a business training; he should learn selling and advertising principles; he should be a close student of economics and politics, for it is the laws of the former that govern supply and demand, and he should certainly receive in some degree what is commonly known as a liberal education. While such a course would take a trifle longer to complete, the man who finished it would be much farther advanced than the pure engineer. It could be made optional, but there is no question that it would soon become the only course, because it is the sensible method.

In the majority of technical schools or state universities such a course is possible if a man will use his "horse sense" in addition to the curriculum as prescribed in the courses. Although there has been some progress in the schools, a great deal more is necessary. The general manager of one of the largest central stations in the Middle West recently observed on this subject: "What we need are not only trained technical men, but men who are more than technical. We need men with business and sales ability, men with initiative and knowledge of human nature, a knowledge which is not gained in the technical courses to-day. We can buy engineering knowledge at any time and at almost any price and anywhere, but we are forced to scour the country for a man who has combined in his make-up the technician and the salesman. It requires the former knowledge to enable a man to know what he is selling and the latter to enable him to dispose of it. Our rates and service may be the most reasonable and satisfactory in the country, but if we cannot market our product, we might as well close down our generators and quit business."

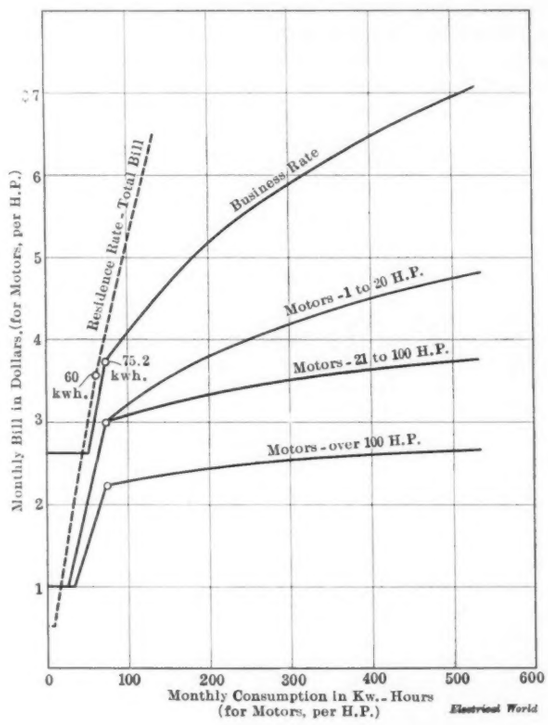
The foregoing is true not only in the electrical field but in other industries as well. Let us have, therefore, more economic engineers.

Lawrence, Kan. F. H. M. RILEY.

Rate Schedules from the Customer's Standpoint

To the Editors of the Electrical World:

Sirs:—The article on "Rate Schedules from the Customer's Standpoint," on page 49 of the issue of Jan. 4, and your editorial comment the following week on "Lucid Rate Schedules," call attention to a detail of central-station management wherein improvement has been remarkably slow. The writer has long been of the opinion that a simple curve plotted between dollars as one co-ordinate and kilowatt-hours as the other is the most feasible way of introducing the customer to the otherwise complex subject of rates.



CURVE ILLUSTRATING FUNDAMENTAL RATE CHARACTERISTICS

Such a curve avoids the annoying difficulties of "minimums" and "base rates." And, especially in lighting bills, it shows the customer at a glance how to translate the kilowatt-hour reading of his meter into the familiar terms of dollars and cents.

For example, the accompanying curve illustrates the fundamental characteristics of the rates charged by the Seattle lighting plant for all classes of service. Of course when approaching a customer with respect to some particular subject, such as residence lighting, only one of these curves, plotted separately and to the most advantageous scale, need be presented.

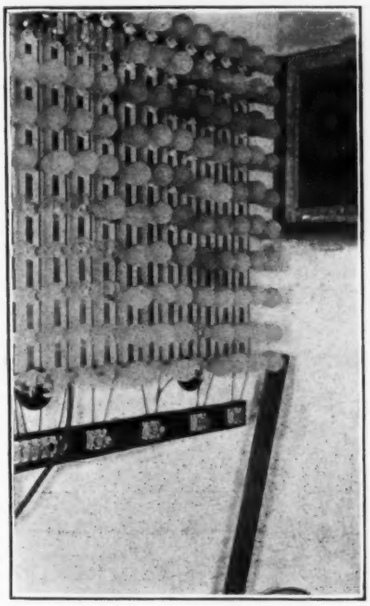
Seattle, Wash. GEORGE HOLMES MOORE.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Lamp Bank for Meter Testing

The accompanying photograph shows a convenient form of lamp resistance in use in the meter laboratory of the United Electric Light Company of Springfield, Mass. The lamps are arranged in banks mounted on a grille of iron straps, 0.125 in. to 0.25 in. in thickness and 1 in. wide. This grille is supported on 2300-volt porcelain insulators bolted into the wall. Clearance of about 8 in. is thus provided between lamps and wall. Carbon-filament units of 2 cp to 50 cp are used. Each circuit is separately fused on a panel, shown in the picture, and connections are carried to switches on the test board in an adjoining room. In the same room is a water rheostat, which is provided with a permanent water-supply connection and a spigot discharge into a trap leading to the sewer, so that the barrel may be conveniently emptied and filled anew as its contents become fouled by electrolytic action.



LAMP BANK FOR TESTING METERS

The 660-Watt Branch-Circuit Rule

Considerable ambiguity still exists in the interpretation of the 660-watt rule, said Mr. W. H. Blood, Jr., Boston, Mass., insurance expert for the National Electric Light Association, in a letter dealing with this rule's bearing on tungsten-lamp circuits, read before the Western Association of Electrical Inspectors' convention at St. Louis, Jan. 28. The rule itself, he pointed out, is further complicated by the requirement that 125-volt branch circuits shall be fused with 6-amp fuses.

In view of the fact that so many heating appliances of about this rating are being sold for use on branch circuits, Mr. Blood asserted that this 660-watt rule is at present a mistake. It is an unnecessary hardship, he declared, to require the running of a separate circuit for a percolator, teakettle or small flatiron. He also insisted that a mistake is made in limiting branch circuits to ten or twelve outlets, for there is no more danger with twenty outlets than with ten. Records would not be likely to show any special menace due to increase in the number of outlets. On the other hand, said Mr. Blood, there ought to be some way of limiting the circuits from the customer's standpoint. It might be a mistake to put twenty lamps on a circuit, for this would mean, in many small installations, that if a fuse blew every lamp in the house would be extinguished.

Investigation will show that there are comparatively few 6-amp fuses used. One manufacturer, for example, last year put out no 6-amp fuses, although he did distribute 5000 10-amp fuses. Another company put out only 1200 6-amp fuses and 32,000 10-amp fuses. Mr. Blood suggested, however, the wisdom of limiting branch circuits to carrying 1000 watts, and providing that these circuits be protected by 10-amp fuses. He also proposed the substitution, as far as possible, of No. 12 wire for No. 14, for with No. 14 the question of drop enters materially.

In this connection the writer recommended the suggestion already made that two types of plugs be used, one a "household plug" to be furnished with all portable heaters taking less than 1000 watts, and all other heaters taking over 1000 watts to be furnished with a larger plug. The latter heaters should be distinctly marked "not suitable for use on lighting circuits," but would be installed on separate circuits with their own switches and pilot lamps.

Plant Changes at Reading, Pa.

Some of the reconstruction work recently carried out at the plant of the Metropolitan Electric Company, Reading, Pa., was particularly interesting in that new floors had to be installed before the old steam-driven apparatus could be abandoned. Special steel columns were designed with splices, so that they could be brought up to position, piece by piece, and later the old wooden floor was used as form-work for the new concrete floor.

The main generating station at Reading gets its cooling water from the river, but this source is not suitable for boiler-feed. On a small creek a mile from the station a good pond was available, but measurement showed only a 13-ft. head between the pond surface and the boiler-feed pumps. Calculations further revealed the fact that a 20-in. or 24-in. pipe line would be needed to keep the friction loss within the exceedingly narrow margin which remained after allowance was made for placing the heater above the feed pumps.

A large number of old boiler shells, however, happened to be available, and these were placed in a trench through the meadow, the joints being sealed up with concrete. Although far from standard pipe-line design, this improvised tube delivers the water with ample pressure.

Meanwhile the system was being converted from 11,000 volts to 22,000 volts, necessitating the change of line insulators, etc. Two gangs, each comprising three linemen and one groundman, were employed on the task. Working at maximum efficiency, it took about twenty minutes to change a pole, and an average day's work (nine hours) was about ten or eleven poles. The maximum was twenty-nine poles. Some days only five or six were changed when corner or double-arm poles were encountered. Work on the corners was very hazardous and could not be accomplished while the line was "hot;" consequently it had to be done on Sundays, when interruptions were not so important. No serious accidents occurred during the work. Tying in was always done on a dead line, the dead line being first grounded or short-circuited. No one was allowed to touch the line until he was sure it was "dead." The cost of the work amounted to $475 per mile, including labor, cross-arms, insulators, etc. The cost of labor per

single-arm pole was about $1.50. Although the cross-arms were found suffering from dry rot, the poles, which were of chestnut, had been in service ten or twelve years, and no sign of rot or decay, even in the gains, was found.

Low-Freezing Mixtures for Oil Switches

By F. W. Harris

It is very common for oil switches to be so located that they are exposed to the action of extreme cold, especially in the northern part of this country and Canada. The effect of such cold on the ordinary transformer or switch oil is first to render it very thick and at very low temperatures actually to solidify it. Even if it is reduced to the consistency of a thick jelly it is likely to interfere seriously with switch operation, and it is desirable in switches so exposed to provide a liquid that is not open to this objection. There are now on the market several oils that have very low freezing points, and the manufacturers of oil switches are ready to furnish such oil at a rather high price, which, however, represents a fair increase over the cost.

In this connection it is desirable to point out that were it not for two features tetrachloride of carbon would be far superior to any oil for use in such switches. It is not inflammable and does not produce inflammable vapors and it has a very low freezing point. It is, however, rather expensive, about seven times as expensive as a good oil, and it is volatile, producing disagreeable vapors at a relatively low temperature. It is probable that if the matter of price could be corrected it would come into very general use for this purpose, special switches being arranged for it. It is valuable for reducing the freezing point of oil, and a half-and-half mixture will not stiffen up appreciably at 20 deg. below zero C. It must however be watched as it evaporates and its use is not to be commended at this time.

There is another substitute, however, that may be used with good effect, and that is turpentine. A half-and-half mixture of good turpentine and ordinary transformer oil will freeze at about minus 30 deg. C. It does not materially lower the breakdown voltage and is not harmful owing to carbonization in breaking the circuit. It is inflammable and evaporates, but the standard low-freezing mixtures and oils all do that so far as the writer is aware. It used to be the practice on the outdoor switches used on the line of the New York, New Haven & Hartford Railroad to use a low freezing oil in the winter and to take it out in the spring and use standard oil in the summer. When operators have trouble with switches freezing this turpentine mixture is a good one to know about, and if a little care is used no harmful results need be feared. It is probably too volatile for summer use, however, and should be removed in the spring before the warm days come.

Facts About the Modern Dry Cell

What are the components of the modern dry cell and what functions do they serve? How are the various parts arranged? Are there any statistics available on the size of the industry? N. U. L.

The manufacture of the common dry cell engages the attention of forty or more separate companies and the magnitude of the industry is little appreciated by those not familiar with it. A year's production of dry cells in this country approximates over $10,000,000 in value. At the present time it is probable that over 50,000,000 standard 2.5-in. by 6-in. batteries are manufactured yearly, 5,000,000 flash-lamp batteries consisting of approximately 15,000,000 single cells 13/16 in. by 2 5/16 in., and about 2,000,000 other cells of special sizes. The present type of dry cell consists of (1) a zinc container, or negative pole, (2) a paper, or porous partition, between the positive and negative poles, and (3) a positive pole comprising a rod of carbon surrounded by a mixture of manganese dioxide, ground carbon and electrolyte. The zinc container is rolled from zinc 0.020 in. thick; the paper partition may consist of three layers of thin blotting paper or a single layer of heavy pulpboard; the positive pole mixture consists of pyrolusite (85 per cent manganese dioxide), 100 parts by weight; ground coke, 80 parts; artificial graphite, 20 parts; sal ammoniac, 20 parts, and zinc chloride, 7 parts. The manganese dioxide acts as the depolarizer; the ground carbon which is next to the paper separator collects the current at the periphery of the mixture and conducts it by means of the other carbon particles to the center carbon plug; the graphite is employed to reduce the internal resistance; the sal ammoniac is the electrolyte, while the zinc chloride is used only to improve the life of the cell by reducing local action. The zinc container is the most expensive part of the cell, and the total manufacturing cost has been given by one authority as approximately 8 cents per cell.

Effects from Railway-Current Electrolysis in Pipe-Grounding Secondary

Some of the building-construction journals have presented articles by engineers in that field pointing out possible dangers from leakage railway-return currents in buildings where ground connections are made to water pipes and other underground piping systems. From a theoretical standpoint it seems possible that stray direct current might cause injury in this way, but no reports are apparently available concerning the occurrence of such damage or investigations made to determine its extent. K. L. S.

The path of the current in producing the possible action described would be from the interior piping system through the grounded secondary connection on the water service, thence over secondary to some other ground, either railway-track, water-main or driven-pipe ground, the amount of current and severity of anticipated trouble being in the order named. Although very little is known of the limitations of such possible current, a few figures recently obtained in Denver by Mr. W. J. Canada, electrical engineer for the Rocky Mountain Fire Underwriters' Association, show that with water-main grounds used exclusively and with areas where sandy soil makes possible the very high voltage drop of 10 to 20 volts between neighboring track and water main, a paralleling No. 4 secondary, grounded by No. 4 to hydrants, showed a maximum current flow of less than 1 amp in the largest reading obtained. This would be very considerably less in the ordinary case since the larger the number of good grounds the less would be the current. From the readings taken by this observer he concludes that direct current on secondaries can never, when secondary connections to water mains are intact, reach an amount at which perceptible electrolytic action begins, even with salt solutions, to say nothing of the ordinary soil conditions. With secondary grounded to driven pipes, there seems, indeed, somewhat greater possibility that the delivery of current from house-service pipes to neighboring pipe grounds placed (as sometimes occurs) near roof drains, and therefore possibly near buried water services, might reach such a voltage as to cause injury to the service pipe, but such action has never been observed. In case the current was reversed, an increase of resistance from the driven pipe to ground might be expected to result from oxidation or from drying out the earth, and has been found to result when current exceeded a small minimum, thus injuring the effectiveness of such driven-pipe ground. While there always exists the possibility that some direct current may be shunted over paths including secondary grounds, it is apparent from theoretical consideration and from experience that such shunting will rarely cause any injury to such grounds either from heating or from electrolysis. Undoubtedly greater current flows are to be expected from varying voltages between incoming gas, water and drain pipes, because of their differing conductivity.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Testing of Direct-Current Traction Motors.—WALTER E. FRENCH.—An illustrated description of a slightly modified "Hopkinson or return-current test" to meet the special requirements of traction motor testing. Two similar traction motors M and G (Fig. 1) are suspended by their axle bearings on a common shaft S. They are mechanically coupled through their spur gearings p_1, p_2; hence the speed

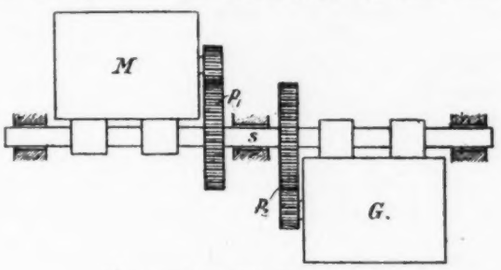


FIG. 1—DIAGRAM OF COUPLING

of both machines is the same. They are electrically connected according to Fig. 2, one machine being run as a motor, the other as a generator. The motor armature M, the motor field F_m, and the generator field F_g are all in series. Both machines have the same speed and excitation, and as identical flux conditions prevail in both, the iron losses in motor and generator are equal. A booster B_2 (Fig. 2) is placed in series with the generator armature in order to make up the deficiency of the voltage V_g and to raise the pressure in the generator circuit to V_1, the potential difference existing in the motor circuit. This is necessary to effect the "pumping back" of the energy to the motor. The pressure V_m across the motor terminals must be kept constant for all loads, at the voltage for which it is designed, and therefore a second booster B_1 will be required, should the pressure of the mains be too small to allow this adjustment to be done by rheostatic control.

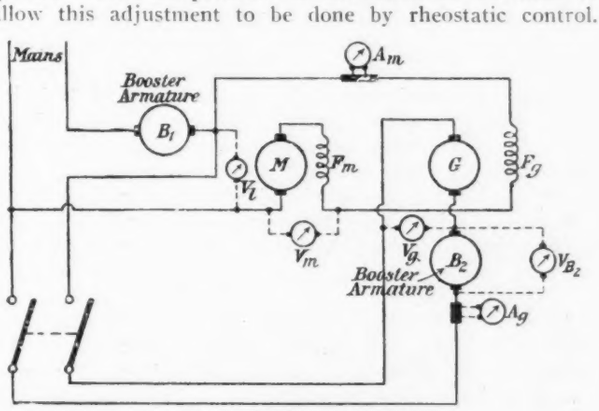


FIG. 2—CIRCUIT DIAGRAM

The product of the current flowing in the generator circuit and the booster voltage in the generator circuit gives the total loss of the set, comprising the iron losses, gear friction and windage losses of the two machines. The resistance of the armatures being known, their Joulean heat losses can be computed. Subtracting these from the total loss, we obtain as a residue the gear friction and windage losses, as well as the field I^2R and iron losses of both machines. One-half of this difference is the wattage lost in the motor alone by friction, windage, hysteresis, eddy currents and field I^2R. The friction includes the losses in the axle bearings, and the efficiencies taken in this way represent the actual working efficiency of the motor on the car. Adding to this the heat loss in the motor armature, the total motor loss is obtained.—London *Electrician*, Jan. 17, 1913.

Pressure Regulation of Direct-Current Dynamos.—A note on a recent (British) patent (No. 28,486, Jan. 9, 1913) of Brown, Boveri & Company. The excitation is pulsatingly varied. The oscillating system to effect this consists of a single electromagnet, excited according to the pressure of the machine, together with an oscillating armature, whose period oscillation is less than that necessary for the regulation, and a retracting spring. The damping is supplied by a short-circuited winding on the field-magnet poles. The resistance to be short-circuited by the oscillating system is in the dynamo shunt-field circuit.—London *Elec. Eng'ing*, Jan. 16, 1913.

Ventilation Arrangement for Large Generators.—KARL WELTZEL.—The author points out several disadvantages in the usual ventilation arrangement in which the cooling air is sucked in from both sides or from the two axle ends of the rotor. The Ganz Electric Company follows a different practice, which is illustrated in Fig. 3. The cooling air is sucked in only from one side of the magnet wheel while the other is completely closed by an iron sheet. Centrifugal force developed in the magnet wheel moves the air in the usual way in radial directions through the stator. The air passes out through a series of holes on one side of the rim into the space between the magnet wheel and the iron

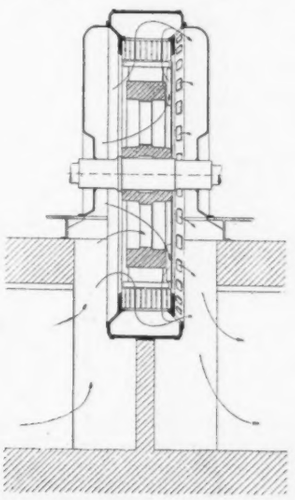


FIG. 3—DIAGRAMMATIC VIEW OF AIR PATHS

sheet. The cooling air is sucked in on one side and blown out on the other through channels in the foundation.—*Elek. und Masch.* (Vienna), Jan. 5, 1913.

Physical Theory of Commutation.—G. W. WORRALL.—The author endeavors to give a physical theory of commutation and discusses especially the self-induction of the short-circuited coil and the magnetic condition of the com-

mutating zone. As to the discrepancy between Arnold's commutating-field theory and Menges' neutral-field theory he thinks that the differences of theory are not real and that if the basis of the arguments be examined in the light of known physical principles the various theories will be found to be merely different ways of stating the same thing. The author's own views are not given as a compromise, but as a basis for a theory which both sides can adopt.—London *Electrician*, Jan. 17, 1913.

Lamps and Lighting

Metallic-Filament Lamps.—A. Lederer.—A paper read before the Association of Austrian and Hungarian Central Stations on the development of the incandescent lamp with special reference to metallic-filament lamps and the work done by Auer von Welsbach. Some microphotographs are given to show the differences between tungsten filaments made by different processes.—*Elek. und Masch.* (Vienna), Dec. 12, 1912.

Generation, Transmission and Distribution

Swiss Water-Power Station.—A note stating that a hydroelectric power station is now being equipped at Laufenburg on the Rhine which will, when completed in 1914, be the largest plant of its kind in Switzerland. The installation will comprise ten turbines, each coupled to a 5200-kw, three-phase alternator, generating at a voltage of 6000 to 6600, which will be raised to 47,000 volts for transmission.—London *Electrician*, Jan. 17, 1913.

Producer Gas.—H. A. Humphrey.—A paper read before the (British) Institution of Civil Engineers on the generation and distribution of producer gas in South Staffordshire. It is a pioneer undertaking, since it is the first example of a company giving, under Parliamentary powers, a supply of producer gas for public purposes. There are eight Mond gas producers, one of which is a spare. Each producer is rated at 20 tons of coal per twenty-four hours, but in the course of operation the plant, which was designed for gasifying 140 tons per day, has reached the rate of 200 tons per day. The Mond producer gas distributed averages over 150 heat units per cubic foot, and the regularity of the calorific value is remarkable. There are at present over 150 gas engines connected with the company's mains, and practically every suction producer situated near the mains has been shut down, the owner finding it more advantageous to take a supply from the Mond gas mains. The average price received from consumers was in June, 1912, about 3.5 cents per 1000 cu. ft., and this is equivalent, having regard to its calorific value, to lighting gas at 14 cents per 1000 cu. ft. A considerable amount of the gas is also used for heating operations.—London *Electrician*, Jan. 17, 1913.

Hydroelectric Power in Switzerland.—In 1911 there were 783 electric power plants in operation in Switzerland, and, as marked evidence of the rapid growth in this branch of industry in that country, there was an increase of 108 electric power plants in one year. Some of the most important sources of water-power are rivers supplied by glacial waters, but, as at certain seasons of the year these are very low, many of the hydroelectric works are obliged to have auxiliary steam or gas engines. The Rhine, for instance, at the point where the important Laufenburg plant is being constructed, discharges 132,000 gal. to 176,000 gal. of water per second, but this amount is reduced to about 60,000 gal. during nearly two months each year. It is estimated that Swiss waters are capable of furnishing energy to the extent of 2,000,000 hp, and of this amount 500,000 hp to 700,000 hp is now harnessed and in actual use.—London *Electrician*, Jan. 17, 1913.

Installations, Systems and Appliances

The Arc on Opening a Switch.—Wilhelm Hoepp.—A long paper, illustrated by numerous diagrams, read before the Electrical Society of Berlin. The author first describes a series of extended researches on the arc produced on opening a direct-current circuit. Experiments with horn lightning arresters are described, which show that in all cases in which the arc travels to the ends of the two horns the initial direction of the arc is the direct continuation of the horns. The form of the ends of the horn is, therefore, very important, and it makes a great difference whether the ends are slightly bent to one side or not. The direct-current arc is always non-symmetrical and the "stream" from the negative pole seems to be stronger than that from the positive pole. This is especially evident with an arc between two carborundum rods. With a horn lightning arrester the arc rises upward always in a non-symmetrical form. Another interesting point is that if a switch is placed in a metallic casing which is connected with the positive or the negative pole (as is the case with railways and in three-wire systems) it is found that the arc jumps much more willingly (that is, with a lower current strength) toward the casing when it is connected with the positive pole than when connected with the negative pole. The voltage of the arc is the sum of the minimum voltage required to form the arc, the ohmic drop and another voltage proportional to the length of the arc. The minimum voltage required to form an arc between copper electrodes is 20 to 30 volts. If at 600 volts twenty or thirty copper contacts are connected in series and they are all broken at the same time, there will be no arcs. On the other hand, with a single arc gap and higher voltages, above 500 volts, the minimum voltage becomes practically insignificant and the required maximum arc length of the arc itself is approximately 1 mm (0.04 inch) per volt; that is, 500 mm for 500 volts and 1 m for 1000 volts. The distance of the electrodes from each other depends entirely on the form of the contacts. Contacts at which arcs occur in operation should be lubricated only slightly, but often. The author then describes some experiments with maximum-current circuit-breakers and discusses the arc caused by opening an alternating-current circuit. Although if carbon electrodes are used an arc may be easily formed with alternating current if the current and voltage are not too low, the conditions are very different with metallic electrodes. With metallic electrodes the arc is usually extinguished within a half period of the alternating current. There is a certain minimum current which depends on the voltage, the kind of connections and the power-factor, and below this minimum current the arc cannot exist longer than half a period. Below this minimum current the contact may be broken slowly, since the arc is extinguished automatically. Rules are given on the best speed of breaking, etc. In order to utilize the advantages of slowly breaking the contact it is best to use for the electrodes a metallic material of high heat conductivity like copper. In an appendix it is shown that in a non-inductive alternating-current circuit the formation of the arc starts only at very high currents with some metals, and that with inductive loads the formation of arcs can be avoided to a certain degree by a small additional artificial load.—*Elek. Zeit.*, Jan. 9 and 16, 1913.

Wires, Wiring and Conduits

30,000-Volt Polyphase Cable.—W. Pfannkuch.—A translation of his German paper recently abstracted in the *Digest* on the 30,000-volt cable system of the Oberspree central station at Berlin.—London *Electrician*, Jan. 17, 1913.

Electrophysics and Magnetism

Speaking Incandescent Lamp.—Karl Ort and Josef Rieger.—A description of an experiment in which a high-candle-power metallic-filament lamp was made to reproduce speech when telephone currents were passed through the filament. The connections are shown in Fig. 4. The primary circuit of the microphone transformer *MT* contains a powerful microphone *M* and the five-cell storage

battery B, the current supplied to the microphone being about 400 milli-amp. The secondary winding of this transformer (the ratio of transformation being from 300 to 5300) was connected through the condenser (2 mf capacity) to the poles of a 100-cp osram lamp G fed from the 120-volt direct-current supply, the induction coil D being inserted in the circuit. Words spoken into the microphone were reproduced by the incandescent lamp. The filament is subjected to temperature variations due to the speaking currents, and these temperature variations are supplied to the glass globe of the lamp, which produces vibrations of the air. The phenomenon is especially noticeable with high-candle-power lamps the globes of which are made of thin glass.—*Phys. Zeit.*, June 15, 1912.

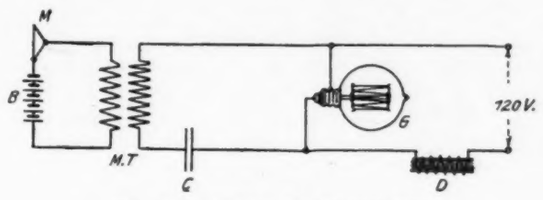


FIG. 4—DIAGRAM OF CONNECTIONS

Changes of Energy.—P. SCHIEMANN.—An article on the changes of energy which take place when an electromagnet or a permanent magnet attracts the armature.—*Elek. und Masch.* (Vienna), Jan. 5, 1913.

Theory of Dielectrics.—TCHESLAS BIALOBJESKI.—A theoretical and mathematical article on the theory of dielectrics based on the ionic theory. The dielectric is assumed to have a lamellar or granular structure, in its interior there being spaces without any conductivity whatever.—*Le Radium*, Vol. IX, 1912, page 250; abstracted in *Elek. Zeit.*, Jan. 9, 1913.

Secondary Rays.—O. W. RICHARDSON.—A mathematical paper on the theory of the non-symmetric emission of secondary rays.—*Phil. Mag.*, January, 1913.

Positive Ions.—G. W. TODD.—An account of experiments on the mobility of the positive ion at low pressure.—*Phil. Mag.*, January, 1913.

Ionization Produced by Beta and Gamma Rays.—D. C. H. FLORANCE.—An account of an experimental investigation of the ionization produced by beta and gamma rays of high pressures. The apparent coefficient of absorption of the beta rays from uranium X was found to be 0.04 cm^{-1} in air. By a special arrangement this value could be reduced to 0.007 approximately. The "emergent" beta rays produced by gamma rays from RaC have an absorption coefficient of 0.046 cm^{-1} air, and the incident beta rays 0.056 cm^{-1} air. The emergent beta rays are similar in penetrating power to the beta rays of UrX. The absorption coefficient of the beta rays of UrX and of the emergent beta rays, when the plates are 2 cm apart, is 0.025 cm^{-1} approximately. The beta rays appear to be independent of the material of the plates, as other investigators have also shown. When the plates are 1 cm apart the ionization due to gamma rays in the gas is negligible at atmospheric pressure and is approximately 25 per cent of the total ionization at 80 atmospheres.—*Phil. Mag.*, January, 1913.

Electrochemistry and Batteries

Induction Furnace.—J. HARDEN.—An illustrated article on the present status of the induction furnace. The author describes the design of a two-phase induction furnace on the lines of the Roechling-Rodenhauser furnace, which is intended to combine the good points of both the three-phase and single-phase types. Some details are given of the construction of the lining, especially the lining developed by the Poldihütte.—*Met. and Chem. Eng'ing*, February, 1913.

Electric Resistance Furnace.—R. H. MCMILLEN.—An illustrated description of the application of the electric resistance furnace to the determination of oxygen in iron and steel by the utilization of the Ledebur method modified to meet the special requirements.—*Met. and Chem. Eng'ing*, February, 1913.

Spray Process for the Production of Metallic Coatings.—M. U. SCHOOP.—An illustrated article on recent advances in the author's spray process for the production of metallic coatings. In the latest apparatus for this purpose just as much metal is melted from a ribbon as is required to be sprayed in that moment on the surface to be coated. The process is applicable to the production of metallic coatings of any kind (brass, copper, nickel, iron, gold and even platinum) on any surfaces whatsoever, even on inflammable substances like celluloid, laces, etc.—*Met. and Chem. Eng'ing*, February, 1913.

Units, Measurements and Instruments

Measuring of Power in Three-Phase Systems.—KARL SCHMIEDEL.—Alternating-current motors with only one measuring system are used with different forms of connections for measuring the power in three-phase systems. But their indications are correct only if all three phases are equally loaded. If the loads are unequal the readings of the meter may be quite wrong. The author calculates exactly the error of the meter reading for the case where one phase of the system is disconnected. This is done for the three principal forms of connections used in practice with induction meters. In the case which occurs most often in practice and in which such meters are used for measuring the power of induction motors, the errors may become so great that either the central station or the consumer will be under serious disadvantages.—*Elek. Zeit.*, Jan. 16, 1913.

Measuring Very High Resistances.—TOURNIER.—An illustrated description of a method for measuring very high resistances, including those of electrolytic resistors, by means of a quadrant electrometer. The connections are shown in Fig. 5, where $V_0 - V_1$ is the potential difference between the needle and one of the quadrants; $V_2 - V_0$ that between the two quadrants. There will be no deflection of the needle if $(r_2 - r_1)x = R(r_1 + r_2) + r_1 r_2$, so that from R, r_1, r_2 it is possible to determine x. In a test of the method the resistances r_{-1}, r_{-2} were constituted of a potentiometer with a total resistance of 110 to 111 ohms. The fixed resistance r was a metallic resistor of 1 megohm. The resistance x to be determined was that of an electrolyte. The source of current S was an alternating-current supply at 110 volts. When x is of the order of magnitude of 10 megohms, the error of the measurement is less than 0.1 per cent; if x is of the order of 100 megohms, it is still less than 1 per cent. The method is particularly applicable to the determination of the resistivity of exceedingly dilute solutions.—*Comptes Rendus*, Dec. 9, 1912; *La Revue Elec.*, Jan. 17, 1913.

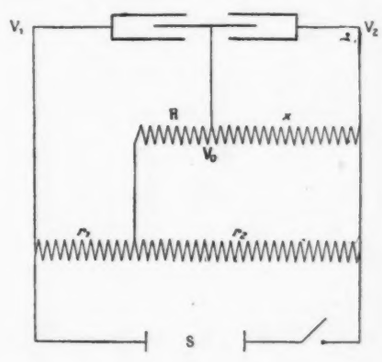


FIG. 5—METHOD FOR MEASURING VERY HIGH RESISTANCES

Telegraphy, Telephony and Signals

Loading Telephone Lines with Induction Coils.—F. Luschen.—A mathematical paper illustrated by diagrams on the calculation of two-conductor and four-conductor lines with Pupin coils in such a way that phantom circuits may be formed.—*Elek. Zeit.*, Jan. 9, 1913.

Telephone Exchange.—An article illustrated by diagrams on the telephone exchange in Rotterdam using the central battery system.—*Elek. und Masch.* (Vienna), Dec. 12, 1912.

Organization of Telephone Exchanges.—Max Freimark.—An article giving a review of the principal features of the organization of American telephone exchanges.—*Elek. Zeit.*, Jan. 16, 1913.

Cable Ship Practice.—E. Raymond-Baker.—An article giving notes for junior assistants on the use of graphs in the cable-ship drum rooms.—*London Elec. Review*, Jan. 17, 1913.

Wireless Telegraphy.—An illustrated description of a new wireless telegraph system is due to J. G. Balsille. The transmitting system (Fig. 7) consists of the usual turned alternator circuit supplying a transformer *E C*, the secondary of which supplies an oscillating circuit. This is across a variable capacity *H* in the antenna, there being no variable coupling. The oscillating circuit contains two capacities, *F* and *G*, which are arranged symmetrically in each connection to the antenna. There is also a reactance *K*, and in shunt to the secondary of the transformer is the spark-gap *L M*, consisting of a plate and nozzle, unidirectional impulses being obtained by an air blast through the latter at 100 lb. to 105 lb. per square inch. In operation the constants of the exciting circuit are so adjusted that it has no distinctive frequency of its own, in order that the radiator may freely oscillate in its own period. The receiving antenna is of the looped type, the extremities of which are connected to earth. One or both legs include a variable condenser around which is shunted a closed oscillating circuit, tuned to the oscillating frequency of the received waves and provided with a variable inductance forming the primary of a transformer. The secondary of this transformer is included in a detector circuit, adapted to be tuned to the group frequency of the received waves.

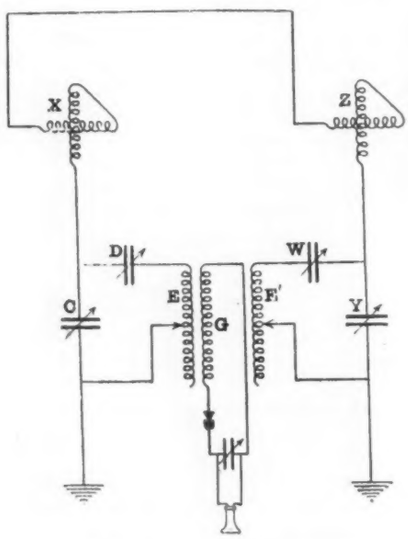


FIG. 6—DIAGRAM OF RECEIVING CIRCUIT

The receiver may thus be tuned to receive from any particular transmitter, working on the two-tone principle and emitting two distinct wave trains of different frequencies, but having a certain predetermined group frequency. The circuit is formed with a variable reactance *X Z* in each leg (Fig. 6). Adjustable condensers *C* and *Y* are adapted to be varied coequally with condensers *D* and *W* respectively, the latter being included in closed oscillation circuits, each of which forms a shunt to condensers *C* and *Y* respectively. These circuits are adapted to be tuned in resonance with the absorbing loop and therefore oscillate in the oscillation frequency of the received waves. The variable inductances *E*, *E'*, respectively, included in each shunt circuit, form the primaries of a transformer, the secondary *G* of which

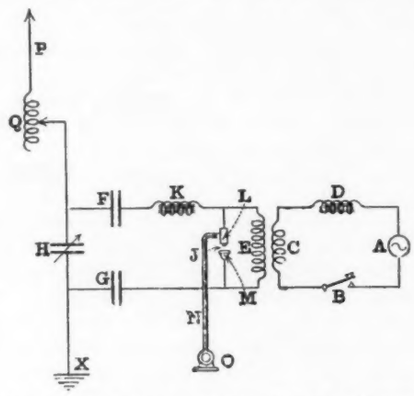


FIG. 7—DIAGRAM OF TRANSMITTING CIRCUIT

forms part of a detector circuit. This is consequently responsive to any oscillation frequency in either shunt circuit through the inductive coupling.—London *Electrician*, Jan. 10, 1913.

Miscellaneous

Thirtieth Anniversary of Society and Journal.—New Year's Day, 1913, was the thirtieth anniversary of the foundation of the Electrical Society of Vienna and also of the foundation of its organ, which first appeared under the title *Zeitschrift für Elektrotechnik* as a semi-monthly. In 1898 it was changed into a weekly and in 1906 the title was changed and the journal became known as *Elektrotechnik und Maschinenbau*, the name under which it has since continued to be published.—*Elek. und Masch.* (Vienna), Jan. 5, 1913.

United States and Europe.—F. Niethammer.—A paper read before the Electrical Society in Vienna on heavy electrical engineering practice in the United States in comparison with European practice. In general the author thinks that the industrial conditions in the United States and in Europe are no longer so different as they were before. The author discusses some special points in the design of direct-current machines, synchronous machines, induction machines and converters. The article is to be continued.—*Elek. und Masch.* (Vienna), Jan. 5, 1913.

Book Review

Handbuch der Elektrizitat und des Magnetismus. By Prof. Dr. L. Graetz. Leipzig: J. A. Barth. 156 pages, 122 illus. Price, 6 marks.

The first of a series of five collaborated volumes relating to the principles of electricity and magnetism from the standpoint of the laboratory worker. This volume deals with the field of electrostatics. The first section takes up the history and elementary principles of electrostatics. The second section deals with electrostatic generators, by friction and inductive influence. Condensers are included. The third section discusses the measuring apparatus of electrostatics. The three sections have been written by different authors. The book is clearly written and well illustrated. The third section is particularly well treated. The student of high-tension electricity will find much interest in the volume, especially on the side of German laboratory apparatus.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Porcelain Pothead

A two-wire, all-porcelain pothead, especially designed for use on arc-lamp circuits, has been placed on the market by the Colonial Sign & Insulator Company, of Akron, Ohio. Though so small as to be inconspicuous when mounted on a pole, it is designed with long arcing distances between

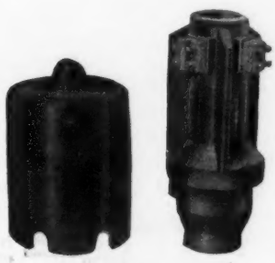


FIG. 1—DETAILS OF POTHEAD

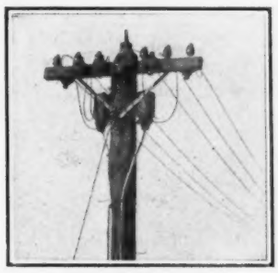
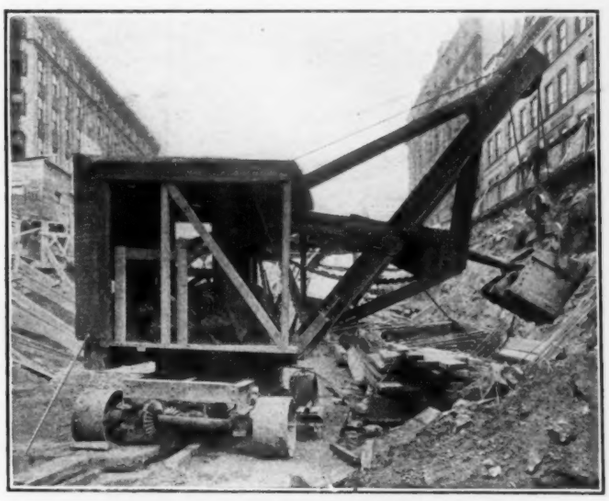


FIG. 2—POTHEAD INSTALLED

live parts, long creeping surfaces and double barriers between terminals of opposite polarity. It is said it will withstand a pressure of 30,000 volts and can safely be used on any arc-lamp circuit for a maximum of 100 lamps. It is designed for duplex cables having a maximum outside diameter of 1⅞ in. with terminals for any size wire up to No. 6 B. & S. gage.

Electric Shovels for City Excavations

Since the smoke abatement law became effective in Boston engineers and contractors have co-operated very successfully to eliminate the smoke nuisance accompanying the use of steam shovels and other steam-operated devices in construction work.



ELECTRIC SHOVEL IN OPERATION ON EXCAVATION FOR NEW CITY HALL, BOSTON

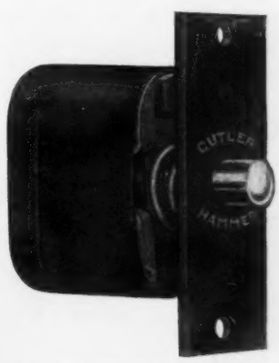
For the new city hall an area of 225 ft. by 60 ft. had to be excavated to a depth of 20 ft. The lot is surrounded by high-class buildings, making noise or smoke objectionable. On this account the contractors, the Wells Brothers Company, New York, decided to use an electric shovel for this work.

The labor cost of operating a Type No. 1 Thew electric shovel with a dipper of 1 cu. yd. capacity on railroad work in Canada varied between 2.9 cents and 3.7 cents per cu. yd. While the conditions were different, it may be interesting to compare this cost with the per diem figures furnished by the Central Construction Company of Boston for operating a Thew Type No. 0 steam shovel. They are as follows: Engineer, $6; fireman, $3; two trackmen at $2.25, $4.50; coal, at $4.50 per ton, $1.25; total, $14.75. The average output for an eight-hour day was about 350 cu. yd., making the cost per cu. yd. 4.2 cents.

The use of an electric shovel also saves a great deal in team time. The crews ordinarily employed in hand shoveling will load a 2-yd. wagon in from six to ten minutes. It is believed that an average saving in team time of three minutes per yard loaded is conservative. This represents a saving of about $9 or $10 daily, an amount almost equal to the entire cost of operating a shovel with a rated output of 35 cu. yd. to 40 cu. yd. per hour.

Automatic Door Switch for Automobile Lighting

A device for the automatic operation of a lamp arranged to light the running board of an automobile when opening the door is shown full size in the accompanying illustration. It automatically closes the circuit and lights the foot lamp when the door of the vehicle is opened, while closing the door causes the lamp to be automatically cut out of circuit. It is of the quick make-and-break type and is rated at 10 amp and 80 volts. The insulating material used in the body is said to be fireproof and waterproof and not to char or warp out of shape. The switch body and push-bar are of rugged construction.



AUTOMATIC DOOR SWITCH

This automatic door-switching device has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Use of Copper-Clad-Steel Tie-Wires

In the construction of 20 miles of 13,000-volt transmission line which the Beacon Light Company, of Chester, Pa., recently completed from Chester to Media, and thence to Philadelphia, No. 4 annealed copper-clad wire was used for tying in the No. 2/0 solid-copper conductors. For work of this character No. 2 copper ties had heretofore been employed, but according to Mr. A. R. Granger, manager of the Beacon Light Company, the use of these will now be discontinued, since he finds the annealed copper-clad wire more economical as well as easier to install.

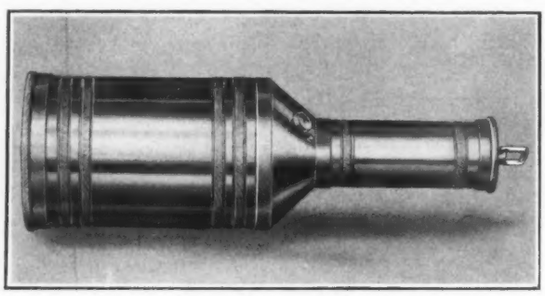
From figures furnished by Mr. Granger in a letter to the Duplex Metals Company, Chester, Pa., manufacturer of the copper-clad wire, the following comparison of costs is given between No. 2 solid-copper wire and No. 4 copper-clad wire for tying purposes:

7270 ft. No. 2 copper, 1461 lb., at 18¾ cents	$273.94
7270 ft. No. 4 copper-clad, 840 lb., at 14¾ cents	123.98
Saving in initial cost	$149.96
Saving in interest charges (fifteen years at 6 per cent simple interest)	134.96
Total saving in fifteen years	$284.92

In addition to this gain in economy secured by substituting No. 4 copper-clad for solid-copper ties of the larger cross-section, the tie-wires are lighter and stronger.

Linemen's Searchlamp

The usefulness of a searchlamp in locating break-downs and other trouble along a transmission line has on several occasions been pointed out in these columns. A new type of lamp for this purpose has recently been placed on the

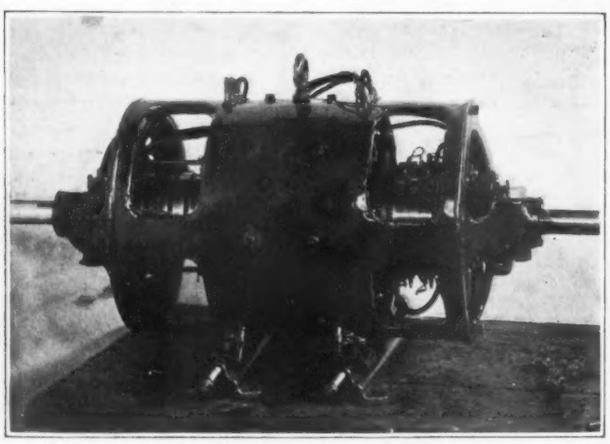


LINEMEN'S SEARCHLAMP

market by the Niagara Searchlight Company, Niagara Falls, N. Y. The lamp illustrated herewith is made entirely of aluminum and weighs only 31 oz. It is said to give sufficient light for illuminating the top of the tallest pole or tower.

Machine for Laboratory Use

The Diehl Manufacturing Company, Elizabethport, N. J., has developed an interpole inverted rotary converter with



LABORATORY MACHINE

special characteristics which make it adaptable for use in laboratories. The machine will generate single-phase or three-phase current at 60 cycles, or it may be operated as a shunt-wound or compound-wound direct-current motor of the commutating-pole type.

In order to make it flexible for testing purposes the machine is equipped with a compound winding on the field spools so that it may be operated as a compound-wound, direct-current generator. When operating as a direct-current generator at a speed of approximately 2200 r.p.m. the machine is flat-compounded from no load to 50 per cent overload. It is equipped with commutating poles and has shaft extensions on both ends in order that arrangements may be made for its operation either as a direct-current motor or a belt-driven generator. When the machine is brought up to speed from the direct-current end it can be synchronized with a three-phase line to operate as an alternating-current motor or as a rotary converter.

Metal Conduits

Several new conduit systems and fittings have recently been brought out by the General Electric Company, Ltd., 67 Queen Victoria Street, London, E. C. In the so-called "Duplex" pin-contact system (Fig. 1) use is made of a double pin or staple which is driven between the wall of the fitting outlet and the tube, thus making electrical contact between successive parts of the conduit through the intervening fittings. The "Magnet" grip (Fig. 2) is a

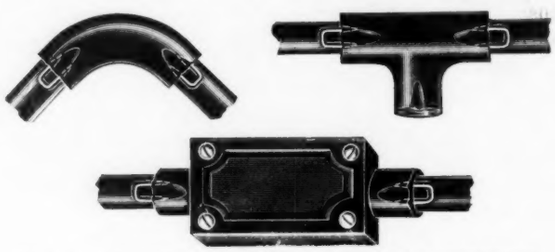


FIG. 1—PIN-CONTACT SYSTEM FOR METAL CONDUITS

steel strap, with two sets of serrated teeth on the inside edges, for making an efficient contact between plain conduit and fittings. It has the advantage of being self-contained, no special fitting being necessary. It is also possible to fit this grip to existing surface installations without dismantling. It is automatic in its action, no scraping or filing of the tube being required.

The "Griptite" fittings are said to possess all the advan-

FIG. 2—GRIP WITH SERRATED TEETH FOR MAKING CONTACT

tages of screwed split fittings, but are simpler and do not require screwed tubes. This system employs non-losable screws which are held in the "lid" half of the fitting so that when the fittings are taken apart the screws cannot

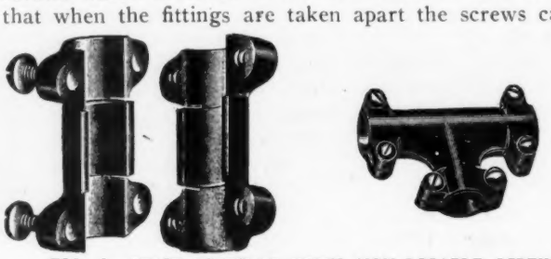


FIG. 3—SPLIT FITTINGS WITH NON-LOSABLE SCREWS

drop out and get lost. When the wires are in place the top halves of the fittings are placed and the screws tightened so as to fasten the fittings securely around the tube. To obtain a proper mechanical and electrical contact the enamel is removed from the end of the tube.

Electrical Equipment for the Melbourne (Australia) Suburban Railways

Probably the most notable railway electrification project at the present time is that about to be undertaken in connection with the suburban steam railways of Melbourne, Australia. The advisability of the step has been under consideration for a number of years, and in 1908 Mr. Charles H. Merz, of the firm of Merz & McLellan, Victoria Street, Westminster, London, presented a comprehensive report on the subject to the Victorian Railway Commission.

Since that time a number of important railways have been electrified in all parts of the world, and experience has demonstrated the great advantages and economies which result from electric operation. In this particular case the rapid growth of the suburban traffic of Melbourne was also a decisive factor that emphasized forcibly the need for electrification. Recent practice especially has shown that the adoption of the high-voltage direct-current system by a number of roads has resulted in successful and economical operation both for suburban and through service.

In a later report, embodying a comparative analysis of the merits of both the single-phase alternating-current and high-voltage direct-current systems, based on the tenders submitted, Mr. Merz claims that the adoption of the high-tension direct-current system for this installation would mean a saving of about $3,500,000, or nearly 30 per cent, in first cost over that of the single-phase system. Furthermore, a saving of about $350,000 per annum, or nearly 28 per cent, in the cost of operation would be accomplished, and consequently the adoption of the high-tension direct-current system was recommended for the Melbourne railways, which recommendation was accepted by the Victorian government.

Melbourne, the capital of the State of Victoria, is situated in the southern part of eastern Australia, on the Yarra River, 8 miles from its mouth at the head of Port Philip. The river is accessible for vessels requiring not over 22 ft. of water, and all larger vessels are accommodated at Port Melbourne in Hobson Bay. Along the river are large docks, shipyards, foundries and manufacturing plants representing a number of industries. The city has a population including its suburbs of over 500,000 and is the most important municipality and the greatest trade emporium in Australia.

The electrification of the Melbourne Suburban Railways is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling-stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that of the third-rail electrified section of the New York Central Railroad out of New York City, and it ranks with the Oakland, Alameda & Berkeley electrification of the Southern Pacific Railroad at San Francisco.

After an exhaustive study and consideration of the relative merits of various propositions, Mr. Merz approved in his report the recommendations of the General Electric Company, New York, as to choice of system and economical features of operation, and the Victorian government awarded to this company the contract for the rolling-stock apparatus equipment, comprising 400 motor-car equipments, consisting of four motors each; 800 control equipments, 400 of which are for trailer cars, and 400 air-compressor equipments. This is said to be the largest single order ever placed for electric railway apparatus.

The mileage of the suburban lines included in the scheme is made up of 150 route-miles, or 289 track-miles of running roads, and 34 miles of sidings. The potential selected for this direct-current system is 1500 volts. Energy will be supplied from a central station at Yarraville, a suburb of Melbourne, in the form of three-phase alternating current at a frequency of 25 cycles per second, which will be transmitted at 20,000 volts to twelve substations at various points on the system, where it will be converted into direct current of 1500 volts. The high-tension transmission is by underground cables from the power house to the substations in the central area, and by overhead wires erected on the structures carrying the railway track conductors to the outlying substations. Overhead railway feeders will be used throughout the system and the cars will be equipped with roller pantograph collectors. The complete equipment involves the expenditure of approximately $12,000,000, and Mr. Merz figures that the saving of electric operation over the steam-operated lines will amount to about $600,000 in 1915.

Normally trains, weighing about 180 tons, will consist of two motor cars and two trailer cars. The track gage is 5 ft. 3 in. In 1908 the suburban traffic amounted to 70,000,000 passengers and last year the figure exceeded 90,000,000. In 1917, when it is expected that the conversion to electric operation will be entirely completed, it is estimated that the suburban lines will carry 150,000,000 passengers per annum. In the present plans provision is made for this probable increase in traffic, but all parts of the electrification scheme will allow extension from time to time as the traffic subsequently grows. The handling of heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for the initial service it is the intention to have the maximum train consist of six cars.

The motors, numbering 1600 in all, which will be installed in the 400 motor cars will be of a new design which is said to embody the most modern developments in railway motor construction. They will have inherent ventilation and be provided with commutating poles. The rating will be 140 hp at 725 volts, two motors being operated in series on a 1500-volt circuit.

It is stated that the method of self-ventilation which will be incorporated in the design of these motors will assure exceptionally effective and uniform cooling by means of a broad-bladed centrifugal fan cast integral with the pinion end armature core head. Fresh air is drawn into the interior through a screened opening on the upper side of the motor frame at the pinion head. This is circulated over the armature and field coils, under and through the commutator, through longitudinal holes in the armature core, and thence exhausted to the exterior through openings in the pinion and bearing head.

The service on the lines calls for both local and express schedules. The motors will therefore be arranged for tap-field control, which will allow a free running speed of 52 miles per hour over level track for the suburban cars on express runs. This method of auxiliary control was introduced by the General Electric Company a number of years ago, but owing to the commutating limitations of the earlier motors it was eventually abandoned. Its successful application to commutating-pole motors is therefore modern.

The principal advantages to be derived from tap-field control are increased operating efficiency, continuous saving of power, economy effected through decrease in the weight of the equipment and an increase in the service capacity. The practical effect of tapping the field is to eliminate one resistance step and to secure the desired accelerating effort throughout, from start to full speed, with a lower current input.

The 800 control equipments for both motor and trailer cars will be of the Sprague-General Electric Type M relay-automatic control, which provides for multiple-unit operation and control of the train from the platform of any motor or trailer car. This type of control has been in operation for many years, notably on the subway and elevated lines in New York and other large cities.

It is interesting to note that two of the principal factors that apparently influenced Mr. Merz and the commissioners to decide in favor of the high-tension direct-current system, rather than the single-phase alternating-current system,

were the lower maintenance of the rolling-stock equipment and the saving in energy consumption. They found that the greater number and complexity of the electrical parts carried on the coaches in the case of the single-phase equipments not only cause these equipments to be initially more expensive but also render them more costly to maintain; and when routine inspection is taken into account, and also the fact that repairs are necessarily subject to the exigencies of traffic requirements, the maintenance of single-phase equipments would exceed that of direct-current equipments in a slightly higher proportion than that governing their respective first costs.

The direct-current motor, known as Type GE-237, selected for these equipments is designed especially to obtain low energy consumption. This comparison of energy consumption is included in Mr. Merz's report in the number of kilowatt-hours required by a four-coach train making a round trip between Sandringham and Broadmeadows. Based on several manufacturers' guarantees, Mr. Merz arrives at an economy of 23 per cent in energy consumption in favor of the high-tension direct-current equipment.

Other points that were brought out as being adverse to the single-phase system for this application might be mentioned, as follows: Slightly reduced seating capacity of the trains on account of the extra amount of room required by the single-phase equipments; the extra wear on the track rails due to the extra dead weight of the single-phase motors, and the extra amount of reserve plant equipment required in connection with the single-phase scheme on account of the greater complexity of the equipments. As mentioned before, Mr. Merz estimated that the annual operating cost of the single-phase system would be about $350,000, or nearly 28 per cent, more than for the direct-current system, and he also came to the conclusion that the latter system would show an increasing advantage over the single-phase system as the traffic becomes yearly greater.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service and, because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions, while the reduction in working cost and the increased earnings of the line combine to increase profits.

Boiler Efficiency Meters

A simple device for indicating the relation between furnace and boiler has been brought out by W. A. Blonck & Company, Fisher Building, Chicago. It consists of two sensitive draft gages, the lower one filled with red oil, indicating the pressure of the air entering into the furnace or the resistance of the fuel bed, while the upper gage, filled with blue oil, measures the amount of gases passing the boiler proper.

In addition to the two gages the meter is provided with two sliding scales, which are adjusted to the best and most efficient operating condition of each particular boiler. The instrument is mounted on the boiler front, so that firemen can see at a glance the working conditions of each unit.

The sliding scales are provided with indications showing normal operation (arrow), excess amount of air (+ air) and insufficient supply of air (— air).

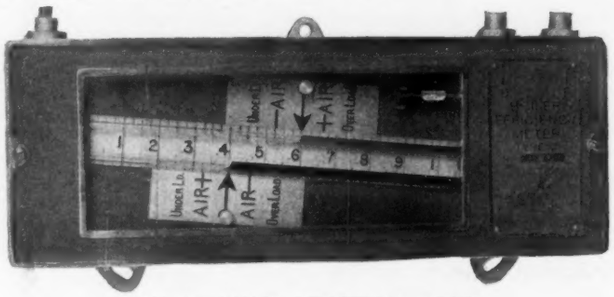


FIG. 2—BOILER EFFICIENCY METER

The connections between the instrument and the furnace and boiler side of the damper, shown in Fig. 1, are standard ⅛-in. steel pipes. This illustration also shows certain positions of the instrument and the deductions to be read from each one. In practical operation the instrument indicates when to put on fresh coal, cover up holes or clean the fire.

Fig. 3 shows the operation of a 300-hp hand-fired Heine boiler as recorded by one of these meters. With a fresh fire the meter would stand at 0.35 and 0.70, indicating normal furnace draft and the friction loss between fire and damper respectively. The firing periods in this case lasted about three minutes. Gradually the scales moved to 0.22 and 0.80, respectively indicating excess of air and the want of fresh fuel. As the fire gets "dirtier" and the cleaning time approaches the meter will gradually move to 0.42 and 0.58, calling the fireman's attention to the lack of air in the furnace. The CO_2 curve plotted on the same sheet shows the greatest efficiency of the furnace at normal positions of the meter.

Electric Passenger Automobiles at Chicago Show

Among the electric passenger vehicles shown at the National Automobile Show held at Chicago, Feb. 1 to 8, were exhibits of the Argo, Baker, Borland, Broc, Buffalo, Century, Chicago, Detroit, Ohio, Hupp-Yeats, Rauch & Lang, Standard, Waverley and Woods cars.

The Woods Motor Vehicle Company made a special feature of its controlling device. Horizontal control is used with five speeds forward and five backward.

The Borland-Grannis Company has a mechanical-electrical controller giving five speeds forward.

Most of the vehicles on exhibition were equipped with dome lamps which illuminate the running board when the corresponding door is opened, but a Waverley car shown

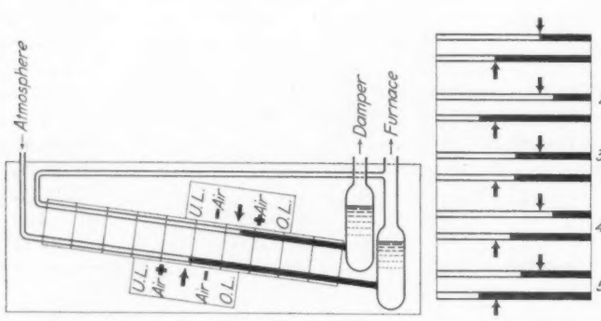


FIG. 3—OPERATING CHARACTERISTICS AS READ FROM METER

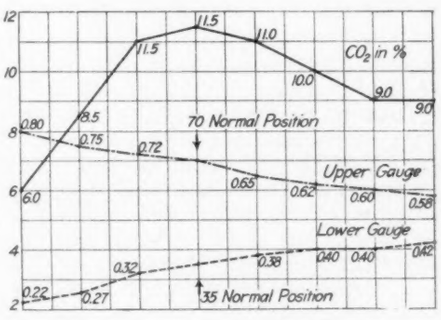


FIG. 1—DIAGRAM OF METER AND EXAMPLES OF METER READINGS

had a special lamp located on a level with the running board.

In the Broc car the batteries are so placed that when the front or rear hood is raised nothing prevents the complete inspection of each cell. This is of great advantage when testing the electrolyte with a hydrometer.

The Ohio Electric Company is one of the concerns building cars which may be operated from either front or rear seat, interlocks rendering it impossible to manipulate both controllers at the same time.

The Ohio car exhibited was supplied with an electric foot warmer. The resistor of the foot warmer makes use of the energy otherwise wasted in the resistance on starting. Another feature on this car is the electric braking, which is accompanied by pressing a button located on the control handle.

To prevent the burning out of brake-bands the Rauch & Lang Company has a new "wrinkle" by which a bell is rung in case the controller is turned on while the brake is set. When the control lever is in the neutral position an electric brake is shunted across the batteries; pulling the handle back farther puts a service brake on the motor.

Only a few of the gasoline cars at the exhibit were not equipped with self-starters of some kind. Practically all of the cars were electrically lighted, the tendency seeming to be toward the 6-volt system. Exceptions were the three-wire, 6-12-volt system and an 8-volt system. In the design of electric starting mechanisms the tendency seems to be toward double-unit sets to obviate gearing complications, one unit being used for starting and another for generating.

Surface Condenser for Brooklyn Edison Company

In the Bay Ridge station of the Brooklyn Edison Company a surface condenser has recently been installed as an auxiliary to the 6000-kw Curtis turbine which is in operation at that plant. The cooling surface available is 20,000 sq. ft., and it is stated that the condenser will produce a 28.8-in. vacuum when the cooling water is injected at a temperature of 70 deg. Fahr. On account of the large amount of foreign substance in the feed water the tubes of the condenser were made approximately twice as large as is the usual practice, the interior measurement being 1.5 in. Under contract conditions it is said that a transfer of about 300 heat units per square foot of surface has been realized, which is quite a remarkable figure in view of the large size of the tubes. The difference between the temperature of the exhaust steam and that of the hot-well is said to be at all times less than 1 deg. Fahr.

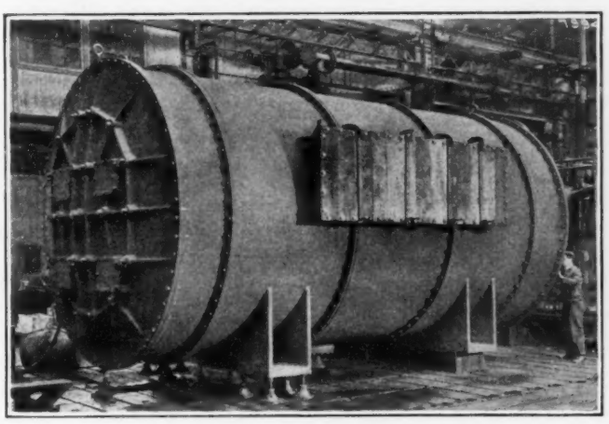


FIG. 1—LARGE SURFACE CONDENSER

In connection with the condenser a Le Blanc air pump and a turbine-driven circulating pump have been installed. The circulating pump is driven from the turbine through a reduction gear. The efficiency of this pump is given as 76 per cent, and the steam consumption of the turbine with all losses included is said to be 53 lb. per water hp-hour. This pump with the reduction gear and turbine are shown in Fig. 2.

As an interesting fact in this connection it may be mentioned that this is the second installation of this type in the United States. The first was made at Terre Haute, Ind., for the Indianapolis & Eastern Traction Company, by the Wheeler Condenser & Engineering Company. In the Brooklyn plant the entire equipment was furnished by the Westinghouse Machine Company, of East Pittsburgh, Pa.

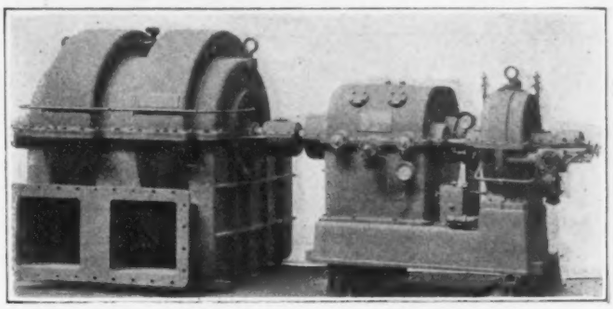


FIG. 2—MOTOR-DRIVEN CIRCULATING PUMP

Outdoor Transformers

It is often desirable to tap a high-tension line where the load is not sufficiently great to justify building a substation, and for this purpose transformers of all ratings and all commercial voltages have been designed for outdoor service.

The familiar pole-type transformers, having a potential of from 2300 volts to 4000 volts, are of simple construction owing to the low voltage. Of the transformers made by the General Electric Company, those with a rating below 25 kva are placed in smooth cast-iron tanks. Units above this rating are provided with corrugated shells in order to obtain sufficient surface for radiation of heat.

TWO TYPES OF OUTDOOR TRANSFORMERS

Transformers rated at 100 kva or above are either self-

cooled or water-cooled. In the former case the shells are made of corrugated sheet steel and in the latter case a plain steel-plate tank is provided. The large radiating surface necessary for self-cooled transformers above 750-kva rating is obtained by compounding the corrugation; that is, two plain corrugated sheets are welded together to form one large corrugation. This tank is said to have about 65 per cent more radiating surface than the plain corrugated tank. Another type of tank for self-cooled transformers is known as the "tubular" or "pipe" tank. This consists of a boiler-plate tank having a double row of vertical steel tubes from top to bottom, thus providing circulation for the hot oil in the tank through these external pipes where the heat is dissipated.

The tanks for water-cooled transformers are made of heavy plain boiler plate, being round for single-phase and elliptical for three-phase units. The General Electric Company has recently delivered three 2750-kva transformers of this type for outdoor operation on 110,000-volt circuits and also several 1000-kva self-cooled transformers in tubular tanks for the same voltage.

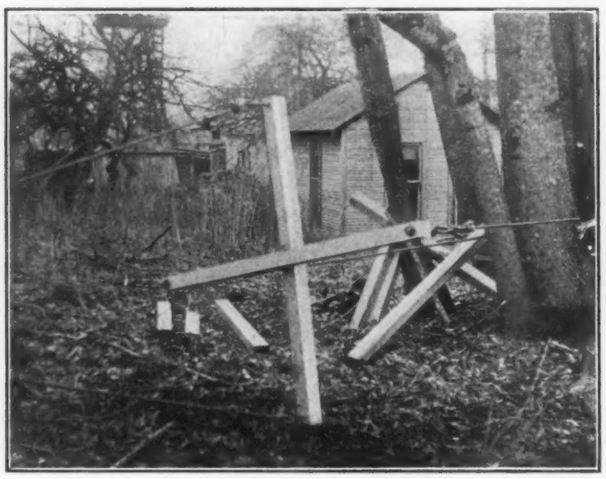


FIG. 1—CROSS-ARMS UNDER TEST

FIG. 2—A VIEW OF THE TESTING APPARATUS

Comparative Tests on Fir Cross-Arms

In Bulletin No. 88 of the United States Forest Service were published the results of a number of tests on the comparative strength of the so-called yellow-fir and red-fir cross-arms. Quoting from this bulletin, the distinction between the two species is as follows:

"Douglas fir varies in color from a decided reddish tinge to a light yellow and on this account is sometimes classified as red and yellow fir. The red fir, as a rule, has a coarser grain and contains a considerable amount of the dark-colored summer wood. It is usually obtained from second-growth timber or from the heart of older trees. Yellow fir is the soft, fine-grained wood obtained from the outer portion of mature trees. It yields a large proportion of clear lumber. The difference in color is supposed to be due mainly to the difference in the rate of growth."

According to these tests, performed on high-grade wood, such as is used in cross-arms, the modulus of rupture of the yellow fir is 6773 lb. as against 7440 lb. for red fir, while the moduli of elasticity are 1,871,000 lb. and 2,106,000 lb. respectively. Again quoting this bulletin: "On the basis of all grades, the difference in favor of the red fir varies from 2 to 4 per cent."

The Barnes-Lindsley Manufacturing Company, Spokane, Wash., recently made some tests on a home-made testing machine at its plant on the Columbia River, which are said to have shown that the red fir averaging from ten to fourteen rings per inch is much stronger than the yellow fir with the closer grain.

The tests were made as shown in the illustrations, a yellow-fir and a red-fir arm being crossed and the strain applied by means of a windlass. There was no way of telling the amount of strain needed to break the arms, as a dynamometer could not be secured. These tests resulted as shown in Table I.

TABLE I—RESULTS OF TESTS ON YELLOW AND RED FIR

Test	Fir	Rings per Inch	Section in Inches	Length in Inches	Result
1	Yellow	15 to 20	2⅞x3¾	62	Broke
	Red	10 to 12	2¼x3¾	62	
2	Yellow	12 to 15	2⅞x3¾	62	Broke
	Red	7 to 10	2¼x3¾	62	
3	Yellow	14 to 20	2⅞x3¾	62	Broke
	Red	8 to 12	2¼x3¾	62	
4	Yellow	13 to 18	2⅞x3¾	62	
	Red	9 to 12	2¼x3¾	62	Broke
5	Yellow	15 to 21	2⅞x3¾	62	Broke
	Red	7 to 9	2¼x3¾	62	
6	Yellow	16 to 20	2⅞x3¾	62	
	Red	6	2¼x3¾	62	Broke
7	Yellow	14 to 20	3 x4½	62	Broke
	Red	12 to 15	2⅞x3¾	62	

Some time ago a number of cross-arms were obtained from a Western Union Telegraph Company's line at Winnemucca, Nev., after forty-three years of service. Table II shows the condition of some of these cross-arms, those with a coarser grain, or red fir, evidently being in as good condition, if not better, as the close-grained or yellow-fir cross-arms.

TABLE II—CONDITION OF CROSS-ARMS

Number	Rings to Inch	Condition	Remarks
1	6 to 7	Good	Three knots in center, 1-in., 1½-in., 2¾-in.
2	9 to 12	Very good	
3	10 to 15	Very good	
4	15 to 18	Good	
5	21 and closer	Very poor	
6	19	Very good	
7	9	Very good	
8	14	Very poor	
9	15	Very poor	One 1-in. knot
10	17	Good	One 1-in. knot
11	16	Poor	
12	20	Very good	

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Crude-Oil Engine Manufacture.—Since the expiration of the fundamental patents on the Diesel engine numerous manufacturers in this country, attracted by the possibilities of this field, have begun building crude-oil engines operating on the Diesel principle. Several of these manufacturers have obtained licenses from the foreign concerns that were the pioneers in the field, and have thus received the benefit of the shop experience, designs, patterns, etc., of these foreign builders. Among the well-known American manufacturers making crude-oil engines are the Busch-Sulzer Brothers-Diesel Engine Company, St. Louis; Snow Steam Pump Works, Buffalo, N. Y.; Lyons Atlas Company, Indianapolis; Fulton Iron Works, St. Louis; Otto Gas Engine Works, Philadelphia, and the New London Ship & Engine Company, Groton, Conn. One of the largest electrical manufacturers is also about to enter the field. The Fulton Iron Works have the American rights to the complete line of engines built by Franco Tosi, of Legano, Italy, but are still in the preparatory stage. The Otto company has built only one size thus far, a 50-hp engine of the horizontal type. One of these engines has been used for driving part of the company's works for some time. On tests made when operating on one of the heaviest grades of Mexican crude oil, a fuel consumption of one-sixteenth of a gallon per brake hp-hour was shown by the engine on a ten-hour run. The Snow company is building crude-oil engines in both single-cylinder and twin-cylinder types, in sizes from 50 hp to 600 hp. These engines have been operated satisfactorily on the heaviest grades of Mexican crude oil, running as high as 54 per cent in asphalt, and also on California crude oils averaging in the neighborhood of 35 per cent asphalt. In the past four or five weeks the company has been operating its engine on coke-oven tar from the Joliet works of the Illinois Steel Company and from the Buffalo plant of the Lackawanna Steel Company, in addition to running it on carbureted water-gas tar from several illuminating gas plants in various parts of the country. The company has several 450-hp engines on order for driving alternators. These units will be installed in Mexican lighting plants, where they will be operated on Mexican crude oil. Many small units, the smallest being of 50-hp rating, are also being completed in the Snow shops. The New London Ship & Engine Company, which has been building a marine-type Diesel engine for some time, is also building the stationary type. The company has obtained the exclusive American rights to all types of heavy oil engines developed by the Maschinenfabrik Augsburg-Nürnberg A. G., of Germany. The stationary type will be built in single-cylinder designs of 100 hp and 150 hp, in two-cylinder designs of 200 hp and 300 hp, and in four-cylinder designs of 400 hp and 600 hp. Any size, or type, between the foregoing and the horizontal, four-cycle, tandem-compound, double-acting engine up to 2000 hp will also be built on order. The new London company has been operating a 200-hp engine, belted to a generator, at its works for several months. In November, with an average load of 78 kw, carried for 33.5 hours, the cost per kilowatt-hour delivered at the switchboard was $0.0119. The total cost covered 274.5 gal. of fuel oil at $0.056 per gal., 10.5 gal. of lubricating oil at $0.28 per gal., and $10 for attendance. In December the unit was run for 110.6 hours with an average load of 61.5 kw, at a cost of $0.0124 per kw-hr. The cost in this case included 705.78 gal. of fuel oil, 43 gal. of lubricating oil and $32 for attendance.

Foreign Capitalists End Their Tour of United States.—The party of English and American bankers and public-utility officials mentioned in the *Electrical World* of Jan. 25, page 213, as being on a tour of this country, were in Chicago on Jan. 27. The visitors spent one day in Chicago and were escorted to points of interest and entertained by a delegation of local electrical men. The party were taken in automobiles to the Fisk and Quarry Street generating stations in the forenoon, took lunch at the South Shore Country Club, inspected the Northwest generating station in the afternoon and had dinner at the Blackstone Hotel. After a theater party in the evening the travelers took the train for Keokuk, Ia., where the hydroelectric development of the Mississippi River Power Company was the next item on the itinerary. Owing to a number of business matters requiring their attention before sailing for London, the visitors were obliged to curtail their tour to some extent, and the original itinerary referred to on Jan. 25 was not therefore followed in its entirety. The party returned to New York this week. The visitors will sail for London on Feb. 11.

Western Electric's 1912 Business.—While final figures showing the results of the year 1912 will not be completed prior to April 1, the sales of the Western Electric Company last year amounted to over $71,000,000, as was noted in these columns Jan. 18. This figure is slightly in excess of the total in 1906, which heretofore was the biggest year in the history of the company. The increase has been in American sales outside of the Bell system, which have increased about 100 per cent over 1906, and in European sales, which were the largest in the company's history. The results have been accomplished by an aggressive selling campaign in the face of increased and increasing competition. The company is now selling to upward of 30,000 customers in the United States alone. It is expected that the profits will be satisfactory, considering the wider distribution and increased competition. The board of directors has established two additional vice-presidents in the company's organization and has appointed to these newly created positions Gerard Swope, general sales manager, and A. L. Salt, general purchasing agent.

To Develop Water-Power Sites Near Hot Springs, Ark.—Following investigation by Ford, Bacon & Davis, 115 Broadway, N. Y., of the water-power resources of the Ouachita River, Arkansas, plans are being completed for the erection of a hydroelectric station on that river about 6 miles from Hot Springs. Part of the energy generated at this station will be supplied to the Little Rock (Ark.) Railway & Electric Company, which is a subsidiary of the American Cities Company, New Orleans, of which George H. Davis, of Ford, Bacon & Davis, is president. Details of the plan are not known at this time.

Salmon River Power Company (N. Y.) to Sell Bonds.—The Public Service Commission for the Second New York District has authorized the Salmon River Power Company, which has a 15,000-hp hydroelectric station under construction about 40 miles north of Syracuse, N. Y., to issue $882,000 forty-year 5 per cent gold bonds to be sold at not less than 85. A reference to the station of this company and the transfer of its common stock to the Niagara, Lockport & Ontario Power Company appeared in the *Electrical World*, Oct. 12, 1912.

American Power & Light Declares Initial Dividend.—An initial dividend of 1 per cent on its common stock, payable March 1 to stock of record Feb. 20, has been declared by the American Power & Light Company. The latter is controlled by the Electric Bond & Share Company and is a holding corporation for the Kansas Gas & Electric, Pacific Power & Light, Portland Gas & Coke and Texas Power & Light companies.

Lambertville (N. J.) Company Sold.—At the annual meeting of the Lambertville (N. J.) Heat, Light & Power Company recently, control of the company passed to F. S. North, of Bay Shore, L. I., and associates. It is stated that the new owners are planning improvements to the station and extension of the company's lines.

Public Utility Earnings Show Improvement.—Noticeable increases in earnings are shown in the annual reports of public utility companies for 1912. The income account of the Detroit Edison Company for the year ended Dec. 31, 1912, including the earnings of the Eastern Michigan Edison Company, shows gross revenue of $4,385,615 as compared with $3,598,094 in 1911, an increase of $787,521; net earnings of $1,858,434, as compared with $1,536,904, an increase of $321,530, and surplus earnings of $1,145,509, as compared with $853,174, a gain of $292,334. The report of the Southern California Edison Company for the year ended Dec. 31, 1912, shows net earnings of $2,001,414, an increase of $109,134. The balance available for dividends on the common stock was equal to 13.21 per cent on the outstanding issue, as compared with 9.7 per cent in 1911. The gross income of the Pennsylvania Water & Power Company for the year ended Dec. 31, 1912, was $721,883, as against $516,285 in 1911, a gain of $205,598. Net earnings were $619,908, as compared with $447,325, an increase of $172,583, and the surplus for the year was $235,769, as compared with $66,200, a gain of $169,569. The gross earnings of the Columbus (Ohio) Railway & Light Company were $2,944,052 last year, as compared with $2,824,489 in 1911, an increase of $119,563; net earnings were $1,347,837, as compared with $1,321,432, a gain of $26,405, and the surplus for the year was $75,014 as compared with $88,420, a decrease of $13,406. Plans for reorganization of the Columbus company are now under the consideration of a committee composed of ten men from the boards of the operating and subsidiary corporations.

Planning Transatlantic Wireless Service.—H. Bredow, managing director of the German Telefunken Wireless Telegraph Company, has arrived here from Berlin in order to take up the question of establishing a transatlantic wireless service between the United States and Europe. Since 1906 the German Telefunken company has had an experimental station at Nauen, near Berlin, where improvements and new inventions in the field of wireless telegraphy are tested. The station has been continually enlarged and improved in the intervening years, and now works with 500 hp to 600 hp as compared to the 35 hp originally installed in 1906. The result has been an increase in range from about 1000 miles to as much as 4000 miles. It is now intended to open this station for regular public service. The company planned last year to test the practicability of transmitting radiograms to the United States, but the tower at Nauen, which was over 600 ft. in height, was thrown over by a heavy storm before the tests were begun. A new tower, approximately 900 ft. in height, is now under construction. The company, hoping to transmit across the ocean before the completion of this tower, began tests on Jan. 11 with a provisional antenna 400 ft. high. On the first trial the signals sent out from Nauen were distinctly received by the station at Sayville, L. I., belonging to the Atlantic Communication Company, New York, and messages transmitted from Sayville were received at Nauen so as to be distinctly legible, even though the station at Sayville operated at only 45 hp.

Rate Reductions Lowered Union Electric Light & Power's Income in 1912.—A. C. Einstein, vice-president and general manager of the Union Electric Light & Power Company, St. Louis, attributes the decrease in that company's income in 1912 to the rate reductions that were placed in effect last year. On this point the annual report of the company states: "While the increase in energy sold to commercial and residence consumers amounted to 11.4 per cent over 1911, the increase in gross earnings from this source was only seven-tenths of 1 per cent because of the material reductions in rates inaugurated during the year, this decrease being approximately 9½ per cent in the average net rate received. Because of the reduction in the residence rate of 22½ per cent there has been a decrease in revenue from residence customers of 4 per cent. The number of residence customers has increased 18 per cent. The financial operations of the year 1912 are shown in the following figures: Gross earnings, $3,663,621.67; operating expenses, $1,943,646.43; gross income, $1,720,175.24; interest charges, $842,927.70; net income, $877,247.54. During the year more than 371,000 tons of coal were used and for labor and salaries approximately $800,000, or over $2,200 a day, was expended. The taxes paid to the city and State aggregated approximately $294,000, an increase of $29,000 over 1911."

January Incorporations Show Increase.—Papers filed in the Eastern States in January for companies with an authorized capital of $1,000,000 and over represented a total of $332,450,000, says the *Journal of Commerce*, New York. This is an increase of $132,350,000 over the December total and of $121,930,000 as compared with that in January, 1912. Charters taken out by other companies with an individual capital of $100,000 or more, but under $1,000,000, last month represented a total capitalization of $64,527,500, which brings the total for the month up to $417,477,500. This compares with $252,300,000 in December and with $330,879,000 in January, 1912.

Lets Contracts for Worldwide Marconi System.—Contracts have been let to the J. G. White Engineering Corporation by the Marconi Wireless Telegraph Company for the erection of eight wireless telegraph stations, two pairs for transatlantic service and two pairs for transpacific service. Receiving and sending stations 30 miles apart will be erected at Oahu, in the Sandwich Islands; Tomales Bay and Bolinas, Cal.; near Belmar, N. J., and also at a site in eastern Massachusetts, not yet selected. These stations will be part of a globe-encircling system which will continue to the East by way of Japan.

Atlantic Gas & Electric to Issue Securities for Acquiring Pennsylvania Properties.—As was noted in these columns Jan. 25, the Atlantic Gas & Electric Company, recently incorporated under Connecticut laws with an authorized capitalization of $37,500,000, has made a proposition to the stockholders of the Eastern Pennsylvania Power Company to exchange their holdings for its securities. In accordance with this plan the Atlantic Gas & Electric Company will issue $2,000,000 first-mortgage 5 per cent bonds, $1,750,000 convertible 6 per cent preferred, and $3,500,000 common stock.

Complete Toledo Railways & Light Reorganization.—With incorporation of the Toledo Traction, Light & Power Company under Maine laws, with $8,000,000 6 per cent preferred and $9,200,000 common stock, the reorganization of the Toledo Railways & Light Company has been completed. The stock and 4 per cent collateral trust bonds of the latter will be taken over by the new company.

United Public Service Company Organized.—The United Public Service Company has been incorporated in Delaware with a capital of $10,000,000. It will take over the electric-service properties at Paris and Danville, Ky., the gas plants at Paris, Ky., and Oberlin, Ohio, and the electric-service properties at Ravenna, Ohio. The main offices of the company will be at St. Louis.

Westinghouse Machine's Refinancing Plan.—Holders of all but $125,000 of the $4,605,000 outstanding extension notes of the Westinghouse Machine Company have announced their intention to exchange these notes for bonds of the company in accordance with the proposition made recently by the company. An outline of this proposition appeared in these columns Oct. 12, 1912.

Allis-Chalmers Reorganization.—In accordance with the plan for reorganization of the Allis-Chalmers Company the latter's Wisconsin properties were sold in Milwaukee Feb. 3 for $2,500,000 to J. H. McClement, of New York, chairman of the reorganization committee. The company's Illinois and Pennsylvania properties are to be sold during this month.

Annapolis (Md.) Gas & Electric Company Sold.—The Washington, Baltimore & Annapolis Electric Railway Company has taken over the Annapolis Gas & Electric Company, which was recently acquired by the Annapolis Utility Company. The latter is controlled by the Washington, Baltimore & Annapolis company.

Mississippi River Power Company to Raise Additional Capital.—It is stated that the Mississippi River Power Company is planning a bond issue of $6,500,000 to carry out plans for the completion of the station at Keokuk, Ia.

Robbins & Myers Company Increases Capital.—Notice of an increase in its capital from $50,000 to $1,000,000 has been filed at Columbus, Ohio, by the Robbins & Myers Company, of Springfield, manufacturer of motors and fans.

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	Jan. 29	Feb. 5
Allis-Chalmers, t.r., 3d pd...	$15,501,800	.....	.....	4½*	4
Allis-Chal., pf., t.r., 3d pd...	13,475,200	.....	.....	9½*	9⅝
Amalgamated Copper.....	153,887,900	1½	Q	72½	71⅞
American Tel. & Tel.....	334,852,900	2	Q	133¼	131¾
Electric Storage Battery, c.	16,074,425	1	Q	53½	53½
General Electric.....	101,203,000	2	Q	142½	142
Mackay Cos., c.....	41,380,400	1¼	Q	84⅜*	84
Mackay Cos., pf.....	50,000,000	1	Q	67½*	67
Western Union Tel.....	99,745,400	¾	Q	72*	72¼
Westinghouse, E. & M., c....	33,737,350	1	Q	74½*	73
Westinghouse, E. & M., pf..	3,998,700	1¾	Q	119¼*	119¼*

*Last price quoted.

NEW YORK METAL MARKET PRICES

	Jan. 28		Feb. 4	
	Bid.	Asked.	Bid.	Asked.
Copper:				
Standard spot	15.50	.....	15.00	.....
	£ s d		£ s d	
London, standard, spot.....	68 12 6		67 17 6	
Prime Lake	16.37½		16.12½	
Electrolytic	16.25 to 16.35		16.00	
Casting	16.05 to 16.15		15.87½	
Copper wire, base.....	18.00 to 18.25		17.50 to 18.00	
Lead	4.35		4.35	
Nickel	40.00 to 45.00		40.00 to 45.00	
Sheet zinc, f.o.b. smelter.....	9.00		8.75	
Spelter, spot	7.00		6.75	
Tin, spot	50.75		49.15	
Aluminum:				
Prompt delivery	26.00 to 26.50		26.00 to 26.50	
Future	26.00 to 26.50		26.00 to 26.50	

OLD METALS

Heavy copper and wire.....	14.25	14.25
Brass, heavy	8.75	8.75
Brass, light	7.75	7.75
Lead, heavy	4.15	4.15
Zinc, scrap	6.12½	5.75

COPPER EXPORTS IN FEBRUARY

Total tons to Feb. 5.....	6,822

Personal

Mr. John H. Roemer has been reappointed a member of the Railroad Commission of Wisconsin by Governor McGovern.

Mr. W. F. White, superintendent of construction and distribution for the Freeport (Ill.) Railway & Light Company, has resigned.

Mr. Sydney B. Martin, Pittsburgh, Pa., has been appointed consulting engineer for the proposed municipal electric-light plant at Sharon, Pa.

Mr. Louis W. Pratt has been appointed contract agent of the Hamilton (Ont.) Electric Light & Power Company, succeeding Mr. Thomas F. Kelly, resigned.

Mr. W. C. Perry has been appointed local manager of the electric light plant at Mount Sterling, Ill., which is controlled by the Central Illinois Public Service Company.

Mr. E. A. Graham, formerly assistant to Mr. C. R. Ross, resigned, has been appointed to the position of electrical engineer for the Winnipeg Electric Railway Company.

Mr. D. McFarlan Moore, inventor of the Moore light, addressed the Colloquium of the Research Laboratory of the General Electric Company at Schenectady, N. Y., on Feb. 1.

Mr. Richard R. Rice, of the General Electric Company, Lynn, Mass., addressed the members of the Detroit Engineering Society on Feb. 7. His topic was "Steam Turbine Systems."

Mr. Thomas Coleman, until recently with Messrs. Chapman & Walker, Toronto, Ont., has been appointed superintendent of the Charlottetown Light & Power Company of Prince Edward Island.

Mr. S. C. Livergood has resigned as chief engineer for the Central Illinois Public Service Company with headquarters at Taylorville, Ill., and will engage in the electrical contracting business.

Prof. Karl Guthe, of the department of physics of the University of Michigan, spoke on "Electrons" before the Detroit-Ann Arbor section of the American Institute of Electrical Engineers on Feb. 1.

Mr. Chester La Croix, superintendent of the Holden, (Mass.) electric-light plant, since its inception, has resigned his position and entered the employ of the Morgan Construction Company, Worcester, Mass.

Mr. James F. Meister has resigned his position of industrial engineer with the Kansas City Electric Light Company and has opened an office as consulting engineer at 706 Victor Building, Kansas City, Mo.

Mr. R. H. Long, formerly assistant superintendent of the Winnipeg Electric Railway Company's hydroelectric plant at Lac du Bonnet, has been appointed to the position of electrical superintendent of the company.

Mr. D. P. Hodson, a former city judge of Buffalo, has been nominated by Governor Sulzer of New York to succeed Mr. John B. Olmsted as a member of the Public Service Commission of the Second District.

Mr. Dean Treat, formerly district superintendent of the Sterling, Dixon & Eastern Railroad, Dixon, Ill., has resigned to accept the post of general manager of the Wisconsin Public Utilities Company at Green Bay, Wis.

Mr. A. W. Conruyer, of the Milwaukee Northern Railroad Company, has been made district superintendent of the Sterling, Dixon & Eastern Electric Railroad with headquarters at Dixon, Ill., succeeding Mr. Dean Treat.

Mr. Lauren A. Pettebone has severed his connection with the United States Light & Heating Company, Niagara Falls, N. Y., and has accepted a position as purchasing agent for the Ontario Power Company, Niagara Falls, Ont.

Mr. Richard F. Buck, the well-known bridge engineer, has retired from the consulting engineering and contracting firm of Messrs. Sanderson & Porter, New York, and has become chief engineer of the Dominion Bridge Company of Canada.

Mr. Robert Bell, of Montreal, Que., has been appointed general manager of the Maritime Coal, Railway & Power Company which supplies the towns of Amherst, Joggins, Maccan and River Herbert, Nova Scotia, from a power plant at Chignecto.

Mr. Edward E. McCall, a judge of the Supreme Court of the State of New York, has been appointed chairman of the Public Service Commission of the First District, New York, as successor to Mr. W. R. Willcox, whose term expired on Feb. 1.

Mr. C. R. Ross has resigned his position as electrical superintendent and engineer for the Winnipeg Electric Railway Company. Mr. Ross has been with the company in that capacity for the past six years and now leaves to engage in private business.

Mr. George G. Anderson, consulting engineer, Denver, Col., addressed the Colorado Electric Club at Denver, Jan. 30, on the subject of "Future Extension of Irrigation by Pumping," touching on the use of electrical energy to enlarge present irrigated areas.

Mr. W. J. Morrison has been elected president of the Carolina Public Service Company, Atlanta, Ga. The company, which is a newly organized corporation, has taken over electric-lighting plants in Charleston, Columbia, Greenville, Spartanburg and other South Carolina towns.

Mr. John S. Kennedy has resigned as secretary of the Public Service Commission, Second District, New York, effective March 1, to go into private business. Mr. Kennedy has been secretary of the commission since its inception and previous to that time was secretary of the old State Railroad Commission, its predecessor.

Mr. Paul M. Lincoln, general engineer for the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., addressed the Boston Edison Company Section of the N. E. L. A. at its January meeting, discussing a paper prepared by Mr. B. G. Lamme on "Sixty-Cycle Synchronous Converters at Constant and Variable Voltages."

Mr. Seton Porter has been admitted into the engineering and contracting firm of Messrs. Sanderson & Porter, of New York and San Francisco. Mr. Porter is a graduate of

Yale. He has been connected with the company for eight years, during part of which time he was in charge of the Stanislaus power development in California.

Mr. W. I. Middleton, electrical engineer of the Simplex Wire & Cable Company, delivered at the Franklin Institute, on Jan. 29, an illustrated lecture on the manufacture of insulated wires and cables from the first installations of a bare conductor in a trough of resinous material to the complicated designs developed to meet present-day requirements.

Mr. Thomas M. Roberts, who recently resigned his position as professor of electrical engineering at Delaware College, has been appointed chief electrical engineer of the Edison Storage Battery Company, Orange, N. J. Prior to his connection with college work the past year, Mr. Roberts was for ten years engineer with the General Electric Company at the Boston district office.

Mr. Jefferson Alexander, for several years superintendent of the Houghton (Mich.) division of the Houghton County Electric Light Company, has been appointed general superintendent of the entire lighting system, with headquarters at Calumet, Mich. Mr. Alexander takes the place of Mr. P. A. Staples, of Calumet, who resigned to take a position in the sales department of the Mississippi Power Company, Keokuk, Ia.

Mr. Thomas Wickham, vice-president of the Macon (Ga.) Railway & Light Company, the Central Georgia Power Company, the Macon Gas Company and the Central Georgia Transmission Company, has severed his connections with those corporations to become affiliated with the management of the gas and electric companies at Cincinnati, Ohio, controlled by Messrs. A. B. Leach & Company, bankers, of New York.

Mr. Thomas H. Hogg, for some months editor of the *Canadian Engineer,* has been appointed assistant hydraulic engineer of the Hydro-Electric Power Commission of Ontario, effective Feb. 1. Mr. Hogg spent some time on similar work with the Ontario Power Company at Niagara Falls, where he was engaged on stream measurements and investigations on the flow of natural watercourses and feeding of water turbines.

Mr. Walter E. Holland has resigned his position of chief electrical engineer of the Edison Storage Battery Company to take a position as research engineer with the Anderson Electric Car Company, Detroit, Mich. Mr. Holland has been affiliated with the various Edison interests for upward of ten years, and was closely associated with Mr. Thomas A. Edison in the pioneer development work on the alkaline storage battery.

Mr. O. H. Norton, president of the Central Electric Company, of Peoria, Ill., has retired from active business affairs, being succeeded in the practical management of the company by Mr. L. B. Van Nuys. Mr. Norton has been a resident of Peoria for more than fifty years. He was the first city electrician of the city and he established the Central Electric Company of Peoria more than twenty years ago. For some years Mr. Norton has been totally blind and Mr. Van Nuys has been the active outside man of the concern.

Mr. Thomas Chandler, superintendent of the Edison Sault Electric Company, Sault Ste. Marie, Mich., has had granted to him by the board of directors a three months' leave of absence. Mr. Chandler has had some years of very strenuous and exacting work, and the board thought a vacation was needed. Mr. Chandler will spend the time in recreation and travel, chiefly on the Pacific Coast, and he may possibly visit Honolulu. Mr. C. M. Wardwell, for many years with the Eastern Michigan Edison Company, is acting superintendent during Mr. Chandler's absence.

Mr. C. M. Tait has been appointed to succeed Mr. James Bennett as chief electrical inspector of the Canadian Fire Underwriters' Association, Montreal, Quebec. He has been for two years chief assistant to Mr. Bennett, who retires at the end of March, and has had a long experience in electrical work, having been connected with the Westinghouse and General Electric companies and the block signaling department of the Canadian Pacific Railway Company. Prior to joining the Fire Underwriters' staff, Mr. Tait did a large amount of inspection work under the late Mr. F. H. Badger and Mr. W. J. Plews, during the period when inspection was not on such a well-organized basis as it now is.

Mr. F. A. Gaby has been appointed chief engineer of the Hydro-Electric Power Commission of Ontario as successor to Mr. P. W. Sothman. Mr. Gaby graduated with honors in the faculty of applied science of the University of Toronto in 1903 and spent a number of years with the General Electric Company of Canada as erecting and supervising engineer, and later with the city of Winnipeg, Man., where he acted as assistant engineer in the preparation of the designs and specifications of the municipal plant. He has been with the Hydro-Electric Power Commission since 1907, and in 1908 was appointed chief assistant engineer to Mr. P. W. Sothman, which position he held until Mr. Sothman's resignation in July, 1912. As chief assistant Mr. Gaby was closely in touch with all the engineering features of the hydroelectric scheme, and he is thus well fitted to take up the work of directing the commission's extensions. Mr. Gaby was born in Richmond Hill, Ont. He is an associate of both the I. E. E. and A. I. E. E. and is at present chairman of the Toronto Section of the latter.

Mr. Thurston Owens has been appointed general manager of the La Crosse (Wis.) Gas & Electric Company. Mr. Owens entered the lighting business in 1901 in the distribution department of the Central Union Gas Company, Bronx Borough, New York City. Later he was connected with the lighting department of the city of New York and more recently he has been devoting his time to consulting work and as an associate editor of the *American Gas Light Journal.* Mr. Owens has been a frequent contributor to the technical press and the proceedings of gas and electric societies. He is a member of the Board of Educational Control of the National Commercial Gas Association and a corresponding member of the British Illuminating Engineering Society, chairman of the papers committee of the New Jersey State Gas Association, secretary of the publicity committee of the Pennsylvania Gas Association and secretary of the Gas Meeters. The La Crosse company supplies gas, electricity and hot water in the city of La Crosse and was recently acquired by the American Public Utilities Company of Grand Rapids, Mich.

THURSTON OWENS

Obituary

John Patterson, who was instrumental in the formation of the Hamilton (Ont.) Cataract Power Company, and who probably did more for the making and developing of Hamilton than any of its other citizens, died in that city Jan. 26.

Arthur Schoellkopf, president of the Niagara Falls Hydraulic Power & Manufacturing Company, died at his winter home in Miami, Fla., Feb. 4. The Niagara Falls Hydraulic Power & Manufacturing Company is the oldest power company at Niagara Falls, N. Y., having been organized in 1877 when Mr. Jacob F. Schoellkopf, father of Mr. Arthur Schoellkopf, purchased the canal property and all its belongings and rights. Mr. Arthur Schoellkopf succeeded his father as president of the company in 1899. The deceased was born in Buffalo, June 13, 1856, and educated in the schools of that city and at St. Joseph's College, Buffalo. He then went to Germany, where he studied in the Kirchheim gymnasium. His first occupation was that of manager of a flour mill at Niagara Falls belonging to his father. Mr. Arthur Schoellkopf was interested in a great many enterprises at Niagara Falls and was at one time Mayor of the city. Two years ago he relinquished active management of the Hydraulic Power company to his son, Mr. Paul A. Schoellkopf, because of undermined health. He is survived by his widow, his son and a daughter.

Construction

KETCHIKAN, ALASKA.—The Citizens' Lt., Pwr. & Wtr. Co. contemplates the installation of a 1000-hp generating unit. The company has sufficient water and piping to provide for the additional unit. J. C. Barber, president and manager of the company, it is said, is now in Seattle making arrangements for equipment for same.

BISHOP, CAL.—The Southern Sierras Pwr. Co. has started a reclamation project comprising approximately 1000 sq. miles lying between Bishop and the summit of the San Bernardino Mountains. Electricity generated by the Bishop Creek power plant will be utilized to drive the pumps, which will furnish water for the development of about 600,000 acres. According to the present plans, the main transmission line will connect near Bishop with the hydroelectric development.

FOWLER, CAL.—The Town Trustees have awarded the contract for street-lighting to the San Joaquin Lt. & Pwr. Co., of Fresno, for a period of two years. The installation of the new system will necessitate an expenditure of about $5,000 on the part of the power company. The contract for street lamps calls for 42 lamps of high candle-power.

HAYWARDS, CAL.—An election will be held on Feb. 27 to vote on the proposition to issue $14,000 in bonds, the proceeds to be used for construction of fire house and fire-alarm system. Of the proceeds $4,000 will be used for the fire system.

LOS ANGELES, CAL.—The Southern California Edison Co. has received authority from the State Railroad Commission to issue $2,500,000 in bonds, the proceeds of $1,000,000 to be used for completing a unit for the Long Beach steam plant, the balance for additions and improvements to existing stations, hydroelectric plants, new transmission and distributing lines and construction of a $100,000 addition to the general office buildings in Los Angeles.

SAN FRANCISCO, CAL.—Plans and specifications have been prepared by Frederick H. Meyer, Investment Building, San Francisco, for a one-story reinforced concrete substation, to be erected by the Pacific Gas & El. Co. on Townsend Street between First and Second Streets.

FORT COLLINS, COL.—The City Council has decided to call an election on March 25 to vote on the proposition to install a municipal electric-light and power plant.

WATERBURY, CONN.—The contract for the construction of power house and coal bin, to be erected on West Main Street for the American Brass Co., has been awarded to Charfield & Chatfield. James R. Coe is engineer.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 18, for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 5152—72,000 ft. portable, ship-lighting cable, miscellaneous lead-covered, single-conductor cable, 72,000 ft. incandescent lamp cord, miscellaneous single and duplex, lighting and power wire, 12,000 ft. twisted telephone wire, miscellaneous weather-proof wire; Schedule 5153—miscellaneous interior communication cable, 60,000 ft. copper-clad steel-wire cable, 3000 ft. silicon bronze conductor, 9000 ft. triple silk conductor, 60,000 ft. flexible silk conductor, 45,000 ft. telephone cord, 300,000 ft. bell wire, miscellaneous plain single-conductor wire, miscellaneous plain twin-conductor wire. Philadelphia, Pa., Schedule 5152—miscellaneous varnished-cloth-insulated double-braided cable. Eastern, Schedule 5153—miscellaneous magnet wire. Boston, Mass., Schedule 5148—two storage-battery trucks. Schedules can be obtained upon application to the navy pay office nearest to each navy yard. T. J. Cowie is paymaster general, U. S. N.

BOISE, IDAHO.—The Local Light Improvement District No. 1 has completed plans for the installation of an ornamental street-lighting system. The plans provide for the installation of 200 ornamental lamp standards carrying a magnetite-arc lamp of 700 cp, maintained by underground wires. The cost of the system is estimated at about $34,019. Contract for installing the system will be awarded early in February. The Idaho-Oregon Lt. & Pwr. Co. submitted the lowest bid.

CŒUR D'ALENE, IDAHO.—The Home Builder Mining & Devel. Co. has bonded its properties for $500,000 and will erect a cyanide plant having a capacity of 5000 tons daily. The company will develop additional water-power.

GRACE, IDAHO.—The Last Chance Canal Co. is contemplating the installation of a hydroelectric plant here.

POCATELLO, IDAHO.—The Idaho Consol. Pwr. Co. has been awarded the contract for furnishing street cluster lamps and incandescent lamps for subway and viaduct in Pocatello.

POCATELLO, IDAHO.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 28 for the construction, including plumbing, gas piping, heating apparatus, electric conduit and wiring and lighting fixtures, of the United States post office and court hourse at Pocatello. Drawings and specifications may be obtained at the above office or from the custodian of site at Pocatello.

POCATELLO, IDAHO.—The City Council has granted L. R. Martineau, of Salt Lake City, Utah, and J. D. Browning, of Pocatello, a franchise to operate an electric street railway in Pocatello and a franchise to install and operate an electric-light plant here. Electricity to operate the system is to be secured from a hydroelectric power plant to be erected on the Port Neuf River at Lava Hot Springs. About 4000 hp will be developed and transmitted to Downey, Bancroft and Pocatello.

DIXON, ILL.—Plans have been completed for the erection of a new power station (to cost $1,000,000) in Dixon, for the Illinois Northern Utility Co. The building will be 100 ft. by 200 ft., one story high. Bids are now being received by Sargent & Lundy, 80 East Jackson Boulevard, Chicago, Ill., for construction of same.

EAST ST. LOUIS, ILL.—L. C. Haynes, vice-president and general manager of the East St. Louis & Suburban Ry. Co. and president of the East St. Louis Lt., Ht. & Pwr. Co., a subsidiary company, has announced that a contract had been signed with the Mississippi River Pwr. Co., which will distribute electricity generated at the Keokuk dam, Keokuk, Ia., for power in East St. Louis.

OGDEN, ILL.—Arrangements are being made to organize a company to supply electrical service in Ogden. It is proposed to secure electricity from the transmission lines of the Illinois Trac. System, of Peoria. H. V. Cardiff and Mr. Scott, both of Ogden, are interested in the project.

ANGOLA, IND.—The Indiana Utilities Co., of Angola Ind., will furnish electricity for lamps and motors in this village, giving a 24-hour service. Tungsten lamps will be used. L. H. Gilbert, of Toledo, Ohio, is installing the wiring system.

FAIRMONT, IND.—Arrangements are being made by the Marion Lt. & Htg. Co. for the installation of a rural service to supply electricity to the farmers between Fairmont and Summitville.

FARMLAND, IND.—The Indianapolis & Cincinnati Trac. Co. has closed a contract to furnish electricity for lamps and motors in Farmland.

KOKOMO, IND.—The Indiana Rys. & Lt. Co. is making extensions to its plant, including new equipment, as follows: Two 500-hp boilers are being installed and it will add one 500-hp, all Stirling; it is installing two 500-hp stokers, Laclede Christy chain-grate, and will install 500-hp stoker; one 3750-kva turbo-generator will be installed soon with switchboard for same; transformers for 500-kw rotary converter; superheater for five 500-hp boilers; new steam piping system for superheat; the erection of several miles of wires for lighting distribution system and 1000 service meters. Most of the material for the above additions has been purchased. P. H. Palmer, assistant general manager and engineer, has charge of the work.

LAWRENCEBURG, IND.—Bids will be received by the Common Council until Feb. 17 for furnishing power-plant equipment for the municipal electric-light plant, in accordance with plans and specifications on file in the office of Frank Goble, city clerk. The equipment will include an engine, a single-phase generator, switchboard and boiler. Paul H. White, Union Trust Building, Indianapolis, is consulting engineer.

PETERSBURG, IND.—The Pike County Tel. Co. has increased its capital stock from $50,000 to $100,000.

SOUTH BEND, IND.—The Indiana & Michigan El. Co., of South Bend, has entered into a contract to furnish electricity for lamps and motors in Walkerton and North Liberty.

ALTON, IA.—Plans have been prepared by the Mason & Mason El. Lt. & Pwr. Co. for improvements and extensions to its power plant in the spring. The proposed work includes the erection of a new building and the installation of a new 60-hp engine and generator.

BLAIRSTOWN, IA.—At an election held recently the proposition to grant the Iowa Ry. & Lt. Co. a franchise in Blairstown was carried.

CONRAD, IA.—The Iowa River Lt. & Pwr. Co., of Eldora, has applied for a franchise to supply electricity in Conrad. A special election will be held Feb. 15 to submit the proposition to a vote.

DYSART, IA.—At an election held recently the proposition to issue $10,000 in bonds for the installation of an electric-light plant was carried.

GREENFIELD, IA.—The City Council has engaged J. B. Hill, consulting engineer, of Iowa City, to prepare plans for changing the municipal electric-light plant from direct-current to alternating-current system.

LEON, IA.—The Leon El. Co. is now placing the cement base for the new engine which it will soon install. The company supplies electrical service in Decatur as well as Leon and will soon furnish electricity in Garden Grove. Ia will also extend its transmission lines to Humeston as soon as possible to supply electricity for lamps and motors there, and will probably extend its circuits to Weldon in the near future. J. F. Smith is president and treasurer and G. A. Havens, vice-president and secretary.

ROLFE, IA.—The Rolfe Lt. & Power Co. will purchase electricity to operate its system from the Northern Iowa Pwr. Co., of Humboldt. The Rolfe company will own the distribution system and substation. Ward Ferguson is secretary and treasurer.

BLUE MOUND, KAN.—At an election held Jan. 20 the proposition to issue $6,000 in bonds to establish a municipal electric-light plant was carried. E. T. Archer & Co., of Kansas City, Mo., are engineers in charge.

FORT SCOTT, KAN.—Estimates are being prepared by F. D. Martin, of Fort Scott, civil engineer, of the cost of the installation of a municipal electric-light plant. The Council recently adopted a resolution advocating the installation of a municipal plant. G. N. Sanford is city clerk.

GOFF, KAN.—The City Council is considering three propositions for lighting the town. Special attention is being given to the proposition submitted by the municipal plant at Seneca, which now furnishes electricity in the towns of Axtell and Oneida, 12 and 9 miles distant. The Seneca plant furnishes a 24-hour service.

NESHO FALLS, KAN.—Petitions are being circulated asking that an election be held to vote on the proposition to issue bonds for the installation of an electric-light plant.

WHITE CLOUD, KAN.—The contract for construction of a municipal electric-light plant in White Cloud has been awarded to the Alamo Engine & Sup. Co., of Omaha, Neb., at $6,306. E. L. Marker is city clerk.

CORYDON, KY.—Bonds have been sold by the city of Corydon to provide funds for the construction of an electric light and power plant. Work will begin on the proposed plant as soon as the weather permits.

DANVILLE, KY.—The Dix River Pwr. Co. contemplates the construction of a large power plant on the Dix River, 8 miles from Danville. The proposed plant will cost about $1,400,000 and will supply electricity in Lexington, Nicholasville, Danville, Lancaster, Richmond and Harrodsburg, with a possibility of a network of interurban lines south of the Kentucky River.

EARLINGTON, KY.—A turbo-generator set will be installed to furnish electricity for lamps and motors for the St. Bernard Mining Co. Frank D. Rash, of Earlington, is interested in the company.

FERGUSON, KY.—The Kentucky Utilities Co. has purchased the franchise sold by the town to supply electricity here. The service will be supplied by the United Wtr., Lt. & Trac. Co., of Somerset, a subsidiary of the Kentucky company, from the plant in Somerset.

FULTON, KY.—The Fulton El. Lt. & Pwr. Co. has made application for a new franchise in Fulton. The company was recently taken over by St. Louis (Mo.) capitalists.

LOUISVILLE, KY.—Bids will be opened about March 1 by Webster Gazlay, of Louisville, engineer in charge of the new power plant to be installed by the Seelbach Realty Company, which owns the Seelbach Hotel, for the erection and equipment of power station, to cost approximately $75,000. The building will be 95 ft. by 100 ft. and four stories high.

PADUCAH, KY.—The Kentucky Southwestern Ry., Lt. & Pwr. Co. contemplates an issue of $1,500,000 in bonds, the proceeds to be used for the construction of its first division from Paducah southwest to Murray, a distance of about 40 miles, work to begin in the spring. The present plans include a system of electric railways, with electric light and power systems in southwestern Kentucky, aggregating about 210 miles. H. C. Rhodes is president and F. M. Smith general manager, both of Paducah.

MARKSVILLE, LA.—Plans are being considered for enlarging the municipal electric-light plant and installing a water-works system. It is proposed to issue $30,000 in bonds to pay for same.

FORT KENT, MAINE.—The Fort Kent El. Co. has applied to the State Legislature asking for an amendment to its charter giving it the privilege to generate and distribute gas and electricity in Fort Kent and the neighboring plantations of Allagash, St. Francis, St. John, Wallagrass and Eagle Lake.

MOUNT VERNON, MAINE.—A bill has been presented to the State Legislature providing for the incorporation of the Mount Vernon Wtr. & El. Co. The charter of the company gives it the privilege of taking water from any source in the towns of Mount Vernon and Vienna and of erecting pole and pipe lines in these towns. The capital stock is placed at $5,000 and may not be increased to more than $20,000. The incorporators are: J. W. Allen, Horace E. Carson, B. Frank Allen, Harry S. Russ, Thomas W. McQuaide and others.

WOODLAND, MAINE.—The St. Croix Paper Co., of Woodland, is building a large dam at Grand Falls on the St. Croix River, about 4 miles from its mills in Woodland. The dam will have a spillway of 900 ft. and is for the purpose of water storage and to generate electricity for its plant. The cost of the dam, including flowage damages, will be about $1,000,000.

HAGERSTOWN, MD.—Application has been made to the Maryland Public Service Commission for the incorporation of the Hagerstown & Frederick Ry. Co. The company is to be capitalized at $3,000,000 and proposes to take over the properties of the Hagerstown El. Ry. Co., the Frederick El. Ry. Co., the Frederick Gas & El. Co. and the Frederick & Hagerstown Pwr. Co.

CAMBRIDGE, MASS.—Steps have been taken by the North Cambridge Business Men's Association for the installation of an ornamental street-lighting system on the North Cambridge section of Massachusetts Avenue. A sub-committee, consisting of C. F. C. Henderson, J. Guiney and C. Burnside Seagreave, has been appointed to secure estimates of costs of installing the system.

FALL RIVER, MASS.—Extensive improvements are under way involving an expenditure of about $300,000 by the Fall River El. Lt. Co. Of this amount $225,000 will be expended to enlarge the main generating station. The building is to be enlarged, a 4000-kw turbo-generator installed and four new boilers added; a new switchboard is to be installed and other improvements are to be made to the Hartwell Street substation, at a cost of $25,000. About $50,000 will be expended in new overhead and underground work and installing new meters. Philip Cabot, of Boston, is vice-president.

ANN ARBOR, MICH.—The Eastern Michigan Edison Co. has applied to the State Railroad Commission for permission to issue $60,000 in bonds, the proceeds to be used for improvements.

BAY CITY, MICH.—Burns & McDonnell, of Kansas City, Mo., consulting engineers, who have been negotiating with the city for the reconstruction of the municipal electric-light plant, have submitted their bid. The cost of the work is estimated at $36,750 and includes the installation of one 750-kw, 2200-volt, three-phase, 60-cycle generator, complete with condenser, pumps, etc., foundations, air ducts, etc., condenser connections, switchboard, two 400-hp boilers, removing old boiler and resetting one, steam piping, heater, moving and resetting feed pipe, rewinding Warren machine, chimney and connections, engineering work and supervision.

DETROIT, MICH.—At the last session of the Common Council an appropriation was asked for placing underground all wires owned by the city on Jefferson Avenue from Gladwin Park to the city limits.

FRANKFORT, MICH.—Bids will be received by the Benzie County Pwr. Co., of Frankfort, about Feb. 15 for the construction of a 1000-hp hydroelectric power plant. S. B. Wiggins, Engineering Building, Ann Arbor, is engineer in charge.

MANISTEE, MICH.—The Manistee Pwr. Co. has applied to the State Railroad Commission for authority to purchase the electric plant of the Manistee Lt. & Trac. Co. in Manistee.

SAGINAW, MICH.—The Saginaw Wood Products Co. is erecting a power plant. The building is of fireproof construction, 100 ft. by 50 ft., one story high.

THREE RIVERS, MICH.—The Middle West Utilities Co., of Chicago, Ill., has acquired the property of the Constantine Hydraulic Co., of Three Rivers, and that of the Milling & Pwr. Co., of Cassopolis, owned by the Constantine Hydraulic Co. A large steam auxiliary steam-power plant will be erected along the lines the Utilities company has acquired in Michigan, probably at Three Rivers. H. C. Sterling is manager of the Three Rivers plant.

ARGYLE, MINN.—The installation of an ornamental street-lighting system in Argyle is under consideration. Local business men are interested.

MANKATO, MINN.—The Mississippi Valley El. Co., of Iowa City, Ia., is reported to have purchased the street-railway system of the Mankato El. Trac. Co.

NEW ULM, MINN.—Plans and estimates are being prepared by the Oscar Claussen Engineering Co., of St. Paul, for the installation of additional units in the municipal electric-light plant.

VESTA, MINN.—The Vesta Hardware Co. has applied for a franchise to supply electricity here.

KANSAS CITY, MO.—The Kansas City Terminal Co. has appropriated $617,000 for the construction of a heating and lighting plant to be erected at Southwest Boulevard and the belt line tracks. The plant will furnish light and heat for the new union station. Bids for the work have already been asked and work will probably begin within 60 days.

RICH HILL, MO.—The contract for construction of the proposed municipal electric-light plant has been awarded to E. J. Merkle, of Kansas City, at $13,600. The contract provides for a Skinner engine, Fort Wayne electric equipment and Wesco (St. Louis) pole-line equipment.

SPRINGFIELD, MO.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 13 for extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of United States post office and court house at Springfield, Mo. Drawings and specifications may be obtained at the above office or from the custodian of building, Springfield, Mo. Oscar Wenderoth is supervising architect.

ST. LOUIS, MO.—Arrangements are being made by Mayor Jost for utilizing electricity generated at the electric plant at the city hospital for maintaining street lamps for a considerable district around Hospital Hill on Gilham Road and over the McGee Street viaduct. At present the plant can supply current for 60 arc lamps. The plant may be enlarged later.

ST. LOUIS, MO.—The United States Public Service Co., recently incorporated under the laws of the State of Delaware, with a capital stock of $10,000,000, will establish headquarters in St. Louis. The company, it is announced, will take over the electric-light plants in Paris and Danville, Ky.; the gas plant in Paris; the gas plant in Oberlin, Ohio; electric plant in Monmouth, Ill.; the electric plant at Mitchell, S. D.; the electric plant at Fort Scott, Kan., and the electric-light plant in Ravenna, Ohio.

JUDITH GAP, MONT.—It is expected that this city will have electrical service by spring. Energy will be secured from the Great Falls Pwr. Co. and will be taken from the Great Falls-Lewiston transmission line at Moccasin and extend down through Hobson, Buffalo and Judith Gap, thence south to Harlowton.

KALISPELL, MONT.—The government has contracted with the Great Falls Pwr. Co. of Great Falls, for 2500 hp to be used in connection with the Sun River irrigation project.

BEAVER CITY, NEB.—A special election will be held Feb. 11 to submit to the voters the proposition to issue bonds for the installation of a municipal electric-light plant.

NORTH PLATTE, NEB.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 27 for the installation of an electric passenger elevator in the United States post office and court house at North Platte, in accordance with drawings and specifications, copies of which may be obtained at the above office. Oscar Wenderoth is supervising architect.

OMAHA, NEB.—Improvements and extensions are contemplated by the Omaha El. Lt. & Pwr. Co. during 1913, which will involve an expenditure of approximately $375,000. The present plans provide for the installation of an 8300-hp turbine engine and generator, a new condenser and two boilers of 500 hp each, extensions of overhead and underground wires, meters and a new intake from the river to furnish water for the power plant. F. A. Nash is president of the company.

FREEHOLD, N. J.—The Monmouth Ltg. Co. will erect about 10 miles of transmission lines. William J. Lansley, Telephone Building, Perth Amboy, is engineer in charge of the work. Peter Vredenburgh is president of the company.

COHOES, N. Y.—The Cohoes Co. has received from the State Land Board the deed for about an acre of land in the Mohawk River, about 600 ft. from the foot of Cohoes Falls. It is stated that the company is preparing plans for the construction of a large plant capable of generating 25,000 hp, to cost about $1,500,000. W. P. Parsons is superintendent of the company.

EDWARDS, N. Y.—The Watertown Lt. & Pwr. Co., of Watertown, has closed negotiations with Woodcock Brothers, of Edwards, whereby it will take over the Cotton Rapids water-power at South Edwards and those adjacent to it, known as the Ball Starch factory and the South Edwards sawmill powers, on the Oswegatchie River. They will furnish a combined head of 100 ft. capable of developing 4000 hp. The company expects to begin the development of its water-power in the spring. C. C. Burns, of Watertown, is president of the Watertown Lt. & Pwr. Co.

HEMPSTEAD, N. Y.—A petition has been presented to the Hempstead Town Board by the taxpayers of the villages of Seaford, Wantagh, Bellmore, Smithville, South and North Merrick, asking the board to establish a lighting district in that section.

MALONE, N. Y.—The Malone Paper Co. has purchased the property of the Malone Lt. & Pwr. Co., including dam, plant and franchise, for $200,000.

MECHANICSVILLE, N. Y.—The Village Trustees have awarded the contract for street-lighting and operation of fire-alarm system to the Halfmoon Lt., Ht. & Pwr. Co. for a period of five years. The company has agreed to install a standard Gamewell air compressor fire-alarm system immediately at its own expense.

NEW YORK, N. Y.—Bids will be received by Joseph Johnson, fire commissioner, until Feb. 10 for furnishing material and installing an incandescent electric-lighting system in the quarters of engine company No. 31, corner of Lafayette Street and White Street. Blank forms and further information may be obtained and plans and drawings may be seen at the office of the Fire Department, 157 and 159 East Sixty-seventh Street, borough of Manhattan.

ORWELL, N. Y.—The Salmon River Pwr. Co., a subsidiary of the Niagara, Lockport & Ontario Pwr. Co., has received authority from the Public Service Commission, Second District, to issue $882,000 in bonds, to be sold at not less than 85, the proceeds to be used for the construction of three dikes, hydraulic and electrical equipment, transmission line, raising dam and other work in connection with its property.

SCHODACK, N. Y.—The Public Service Commission, Second District, has authorized the Schodack Lt. & Pwr. Corpn, to commence construction and exercise a franchise in the town of Schodack.

WHITE PLAINS, N. Y.—The Board of Village Trustees has voted to authorize the employment of an electrical engineer to make a survey of the village and report on the feasibility of installing a municipal electric-light plant, to supply electricity for street lighting and for commercial purposes.

BURLINGTON, N. C.—A proposition has been submitted to the Board of Aldermen offering to purchase the municipal electric-light plant. The corporation proposes to take over the plant and pay the city the amount it cost to build it, the city in return to give the company a franchise to operate an electric light and power plant here and also a contract to light the streets of the city. The corporation proposes to take over electric plants in Burlington, Graham and Elon College and extend the service to Haw River, Swepsonville and possibly Mebane. It is proposed to supply the service from one central power plant.

GREENSBORO, N. C.—A petition has been presented to the City Commissioners for the installation of ornamental street lamps on Elm Street, from Lee Street to Church Street. It is proposed to use ornamental standards carrying five-lamp clusters.

NEWBERN, N. C.—The contract for the construction of a new power station for the city water and light plant has been awarded to H. S. Hancock, of Newbern.

ROCKY MOUNT, N. C.—The question of calling an election to submit the proposition to issue $12,000 in bonds to provide funds for the installation of an additional engine in the municipal electric-light plant is under consideration.

SALISBURY, N. C.—The North Carolina Pub. Ser. Co., of Salisbury, has submitted a proposition to the City Council for the installation of a new street-lighting system. Under the present contract, which has yet three years to run, the city pays $75 per arc lamp per year; the company offers to cancel the present contract and furnish 112 lamps at $65 each per year under a new contract. Bird S. Coler, 43 Cedar Street, of New York, N. Y., is president.

SILER CITY, N. C.—The Siler City Lt. & Tel. Co. has been granted a franchise to install and operate an electric-light plant in Siler City. The company would like to communicate with manufacturers and dealers in electrical equipment and will be in the market for one 50-kw, three-phase, 60-cycle, 2300-volt generator, with switchboard, transformers, meters, etc.; also 10 miles No. 6 copper-covered wire, 6 miles No. 9 copper-covered wire, 8 miles of No. 6 bare copper wire and pole-line equipment. The plant will be located 4 miles from town. Both water and steam power will be used. The company is capitalized at $17,500 and the stockholders are: J. Wade Siler, C. N. Bray, W. D. Siler and J. F. Milliken, all of Siler City.

MILNOR, N. D.—The installation of an electric-lighting system in Milnor is under consideration. Ole Hansen is at the head of the project.

CIRCLEVILLE, OHIO.—The Circleville Lt. & Pwr. Co. has received permission from the Public Service Commission to issue $70,000 in bonds. The proceeds of the new issue are to be used to retire $20,000 in bonds and $10,000 in preferred stock outstanding, to reimburse the stockholders for $29,000 for expenditures made out of the income of the plant, and for improvements to property.

CLEVELAND, OHIO.—Sealed proposals will be received at the office of W. H. Kirby, secretary to the director of public service, 104 City Hall, Cleveland, until Feb. 11, for furnishing and installing ten stokers complete for the municipal electric-light plant. Plans and specifications may be obtained at the office of the engineer of construction, room 319, City Hall. W. J. Springborn is director of public service.

COSHOCTON, OHIO.—The Coshocton Lt. & Htg. Co. contemplates the construction of an addition to its plant, to cost about $60,000.

HINTON, OKLA.—The city has sold the bonds recently authorized for the installation of an electric-light plant. Nothing as yet his been done toward letting contracts. W. L. Benham, of Oklahoma City, Okla., is engineer in charge of the work. C. W. Morrison is city clerk.

PURCELL, OKLA.—The Purcell Bank & Trust Co. is reported to have purchased the local electric-light plant, water-works system and ice factory for the city, for $40,000. It is understood that improvements will be made to the plants and new equipment installed.

STONEWALL, OKLA.—The contract for the installation of the proposed municipal electric-light plant has been awarded to Don A. Tolbert. The work includes the erection of a power house and installation of a 50-hp turbine connected to generator, switchboard, etc.; also the erection of 2 miles of transmission line to the city, with distributing system in city, street lamps, etc., to cost about $12,000. Plans were prepared by J. T. George.

WANETTE, OKLA.—The question of calling an election to vote on the proposition to issue bonds for the construction of a municipal electric-light plant here is under consideration.

BAKER, ORE.—The proposition to issue $160,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

CONDON, ORE.—George Jacobs, of Condon, contemplates the construction of an electric plant on John Day River. Electricity generated at the plant will be transmitted to numerous towns in this section.

CORVALLIS, ORE.—The Corvallis Commercial Club recommends that the city use its right to purchase the electric-light plant and distributing system of the Oregon Pwr. Co. here, to be owned and operated by the municipality.

EUGENE, ORE.—The F. P. Minney Co., of Oakland, Cal., holder of an electric railway franchise in Eugene, which proposes to construct interurban railways through the Rogue River Valley, has closed a deal for the purchase of the F. V. Waite tract, about 1½ miles from Ashland, for $400,000.

HOOD RIVER, ORE.—The citizens of Hood River will build an electric street-car line from the lower section of the city to Ball Park; $10,000 worth of stock will be subscribed for.

HOOD RIVER, ORE.—Injunction proceedings instigated by the Pacific Pwr. & Lt. Co. have been withdrawn and the contract of the city with the Hydro-Electric Co. will now be entered into.

PORTLAND, ORE.—The Portland, Eugene & Eastern El. Ry. Co. has placed orders for 127-lb. girder rails. Transformer stations will be erected at Springfield and Corvallis. New shops will be built in East Portland.

PORTLAND, ORE.—Three important links in a chain of railways that will eventually connect Portland with the principal cities on Puget Sound will be built by the Washington El. Ry. Co. this year, at a cost of about $2,000,000. A. Welch, general manager of the company, states that plans have been completed for construction work, which, in addition to construction of railway, includes a 12,000-hp hydraulic development on Kalama River. The ultimate cost of the line from Portland to Tacoma, Wash., is estimated at about $10,000,000.

ST. JOHN'S, ORE.—Bids will be received by F. A. Rice, city recorder, until Feb. 25 for lighting the streets of the city for a period of five years. Plans and specifications are on file at the office of the city recorder.

THE DALLES, ORE.—The Hydro-Electric Co., of Hood River, has received authority from the County Commissioners to erect transmission lines over certain highways in Wasco County. The City Council has also granted the company a franchise over certain streets in the city. Work on the proposed extension will begin about March 1.

WESTON, ORE.—The Weston Mountain Tel. Co. will erect a telephone line from Weston up the mountain.

PANAMA.—The opening of bids called for by the Isthmian Canal Commission circular (No. 752), dated Dec. 19, to be opened Jan. 30, for furnishing material and equipment for the Cristobal-Balboa transmission line, including steel track-span bridges, copper wire, insulators, ground plates and equipment for substations, has been postponed to Feb. 15, 1913. Major F. C. Boggs is general purchasing officer.

ALTOONA, PA.—The Penn Central Lt. & Pwr. Co., it is announced, will make important improvements and extensions to its system.

COLUMBIA, PA.—The Janson Iron & Steel Co. is planning to install an electric plant in the near future for the purpose of furnishing electricity for lighting its mill and yard.

JOHNSTOWN, PA.—Preparations are being made by the Citizens' Lt., Ht. & Pwr. Co. of Johnstown, to take over the electric companies operating in the eleven surrounding boroughs and townships, and direct their operation from the Johnstown office. The companies to be taken over are the Brownstown El. Co., the Conemaugh Township Lt., Ht. & Pwr. Co., the Daisytown El. Co., the Johnstown Wtr. & Gas Co., the Lower Yoder Township Lt., Ht. & Pwr. Co., the Upper Yoder Township Lt., Ht. & Pwr. Co., the Middle Taylor Township Lt., Ht. & Pwr. Co., the Stonycreek Township Lt., Ht. & Pwr. Co., the Richland Lt., Ht. & Pwr. Co., the Rosedale El. Co., and the West Taylor Lt., Ht. & Pwr. Co. P. H. Morrissey, general manager of the Citizens' company, is president of each of the above companies. H. D. Walbridge is president of the Citizens' company.

MEYERSDALE, PA.—E. H. Wise, of Charleston, W. Va., representing a syndicate operating light and power plants in Ohio, West Virginia and Pennsylvania, is negotiating for the property of the Meyersdale El. Lt., Ht. & Pwr. Co., as well as other properties in Somerset County. If the deal goes through, it will also include the Pennsylvania & Maryland St. Ry. Co., at present operating an electric railway between Garrett and Salisbury, a distance of about 13 miles.

NEW KENSINGTON, PA.—The Allegheny Valley Lt. Co. has submitted a proposition to the Town Council offering to install 160 tungsten street lamps, 30 lamps of 200 cp and 130 of 80 cp, in place of the 76 lamps now in use at no increase in cost of maintenance by the city, provided the contract of the company is extended.

PHILADELPHIA, PA.—The directors of the Philadelphia El. Co. have authorized the installation of a 30,000-kw generator at its main generating plant at Christian Street wharf and of a 7500-kw generator at its Tacony plant, involving a total expenditure of about $1,000,000.

READING, PA.—The City Council has adopted a resolution to appoint a committee of three councilmen to make investigations into the cost of installing and maintaining a municipal electric-light plant.

SHARON, PA.—We are advised that Sydney B. Martin, 616 Penn Building, Pittsburgh, Pa., has been engaged as consulting engineer for the proposed electric-light plant in Sharon.

NEWPORT, R. I.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 21 (extension of date from Feb. 8) for furnishing and installing a direct-current switchboard and station wiring at the naval torpedo station, Newport, R. I., to cost approximately $11,500. Plans and specifications may be obtained on application to the bureau or to the commandant of the naval station, Narragansett Bay, Newport, R. I. H. R. Stanford is chief of bureau.

FORK SHOALS, S. C.—The Katrina Mfg. Co. writes that its power development referred to in the issue of Jan. 4 has been under construction since May, 1912, and will be completed within the next few months. Contracts have been placed for all machinery and most of it has been installed.

GAFFNEY, S. C.—The Piedmont Tel. & Teleg. Co. has petitioned for an amendment to its franchise permitting it to install a common-battery system and make other changes to its plant, involving an expenditure of about $10,000.

DRESDEN, TENN.—A bill has been introduced to the State Legislature to enable the town of Dresden to issue $12,000 in bonds, to provide funds for the installation of a municipal electric-light plant.

ELIZABETHTON, TENN.—Bonds to the amount of $400,000 have been sold by the Watauga Pwr. Co., owners of the new hydroelectric power plant on the Watauga River, near Elizabethton, of which $300,000 represents the cost of the plant. The remainder will be held in reserve for construction of an auxiliary plant and other contemplated improvements. The company now supplies Bristol and Elizabethton with energy and has leased additional power from the Tennessee Eastern El. Co., of Johnson City, which will be transmitted to Johnson City, Jonesboro and Greeneville, Tenn., over transmission lines now being erected.

KNOXVILLE, TENN.—Arrangements are being made for the installation of an ornamental street-lighting system in the business district. The standards are to be erected by the Merchants' Pwr. Co., which will also supply electricity to maintain same under a contract with the city.

DALLAS, TEX.—The city commission has authorized Commissioner Austin to advertise for bids for cable necessary for the new lighting system to be erected on Broadway between Fourteenth and Twenty-ninth Streets. The cost of the cable is estimated at $4,000. It is proposed to erect ornamental lamp standards carrying five-lamp clusters, maintained by underground wires. W. D. Masterton is superintendent of electricity.

DALLAS, TEX.—Mayor Holland has authorized the contract and bond signed between the city and the Dallas El. Lt. & Pwr. Co. for the installation and maintenance of the special illumination system for Main and Commerce Streets, from Houston to Central, for a period of five years. The contract is approximately $50,000 for the installation and maintenance for one year. The plans provide for the erection of 321 iron poles about 18 ft. in height. After the first year the city is to take over the system and will pay $45 per lamp per year. The contract for poles has been awarded to the Mosher Mfg. Co.

EASTLAND, TEX.—The Eastland Lt. & Pwr. Co. will rebuild its plant recently destroyed by fire. The equipment will include one 60-kw, 60-cycle alternating-current Warren generator, either oil or gas engine to be installed; five transformers, three 50-lamp and two 100-lamp. The distributing system consists of about 5 miles of service wire, 75 meters and 800 incandescent lamps. A. A. Abney is manager.

FORT WORTH, TEX.—The Northern Texas Trac. Co. is planning to double-track its line between Fort Worth and Handley, at a cost of about $200,000. The company also expects to extend the double-track from Boundary, Oak Cliff, to Westmoreland, a distance of 2 miles. Work will begin within 30 days.

GALVESTON, TEX.—Proposals will be received by John D. Kelley, city secretary, until Feb. 20 for furnishing, f.o.b. Galveston, 13,000 ft. of steel-armored lead cable, guaranteed for 10,000-volt service. Bids on both varnished-cambric insulation and rubber insulation will be received. Detail information may be obtained from W. D. Masterton, city superintendent of electricity.

GALVESTON, TEX.—Plans are on foot in which the city and county will co-operate for the installation of an ornamental lighting system. It is proposed to erect ornamental lamps along the boulevard which skirts the sea wall for about 4 miles. The present plans provide for the erection of ornamental standards, maintained by underground cables, like those in use on the north side of the boulevard. The cost of the proposed system is estimated at about $20,000. The proposition as it now stands is for the county to install the lighting system and the city to maintain it. Details are being worked out by County Commissioner Fred C. Pabst, chairman of the finance and boulevard committee; City Commissioner V. E. Austin, commissioner of streets and public properties; Judge G. E. Mann, Mayor Lewis Fisher and W. D. Masterson, city superintendent of electricity.

VICTORIA, TEX.—The Victoria Mfg. Co. is planning to enlarge its electric plant. A new boiler room and compartment to provide space for new machinery will be erected.

HONEYVILLE (R. F. D. BRIGHAM CITY), UTAH.—The installation of a municipal electric-light plant in Honeyville has been postponed indefinitely. A. E. Hyde, Jr., of Salt Lake City, is engineer in charge. John G. Wheally is town clerk.

RUTLAND, VT.—The Rutland Ry., Lt. & Pwr. Co. is erecting an electric transmission line from Granville to West Pawlet, where it expects to furnish electrical service about April 1. The company will also erect a line between Granville and Wells; later this line will be extended to furnish electrical service to the cottages on the shores of Lake St. Catherine.

CHRISTIANSBURG, VA.—The Appalachian Pwr. Co., of Bluefield, W. Va., has purchased the property of the Christiansburg Pwr. Co., for $30,000. The new owners have also entered into a contract with the town for furnishing power to the town and for street lighting.

MONTEREY, VA.—The Highland Garage & Lt. Co. will erect a new power plant, plans for which have been prepared by Paul Slavin. The equipment will include a boiler, an engine and a generator. John Lowmann is engineer.

BREMERTON, WASH.—The Puget Sound Bridge & Dredging Co., Central Bridge, Seattle, has been awarded the contract for laying cable across Hoods Canal to supply electricity for lamps and motors in Bremerton from the plant of the Elwha Pwr. Co. The cost of the work is estimated at $5,000.

CENTRALIA, WASH.—H. C. Coffman, representing the Washington-Oregon Corpn., of Vancouver, has petitioned the County Commissioners for permission to construct a power line to Dryad and Doty. The company has a line in operation as far as Meskill.

CHEWELAH, WASH.—The Stevens County Lt. & Pwr. Co., of Meyers Falls, has secured the contract to furnish electricity to the United Copper & Aurora Mining Co., of Chewelah for a period of ten years. The contract provides for a maximum of 1000 hp daily at $40 per hp per year.

ELLENSBURG, WASH.—Improvements are to be made to the municipal electric-light plant, including the installation of a 200-kw generator and switchboard.

KELSO, WASH.—The Washington-Oregon Corpn. will soon begin work on improvements to its local system, involving an expenditure of about $10,000. The new work, it is stated, has no connection with the construction of the Kelso-Castle Rock transmission line heretofore announced.

MOUNT VERNON, WASH.—The Home Wtr. & Pwr. Co. contemplates the installation of a new electrically driven pump to replace the old steam pumping plant here. A new power house is being erected.

NEPPEL, WASH.—The Grant Realty Co., of Neppel, has just completed the installation of a gasoline engine-driven direct-current generating unit. Storage batteries carry the day and part of the night load, and 28 tungsten street lamps have been installed.

NORTH YAKIMA, WASH.—Sealed proposals will be received by the United States Reclamation Service, Department of the Interior, North Yakima, Wash., until Feb. 21, for furnishing electrical apparatus for power plant for storage unit, Yakima project. Bids will also be received by the United States Reclamation Service, North Yakima, until Feb. 15, for furnishing hydraulic apparatus for power plant for storage unit, Yakima project. For further particulars address the United States Reclamation Service, North Yakima. Charles H. Swigart is supervising engineer. Bids will also be received by the United States Reclamation Service, North Yakima, until Feb. 15, for furnishing hydraulic apparatus for power plant for storage unit, Yakima project.

PORT TOWNSEND, WASH.—The Olympic Pwr. Co. has completed the erection of its high-tension line to Fort Flagler. The Olympic company also has a contract to furnish Fort Worden with electricity. The transmission line from the Elwha plant has been erected to the edge of the government reserve. Fort Casey is having a new power plant built.

SEATTLE, WASH.—The proposition to issue $2,000,000 in bonds for the installation of a municipal telephone system will be submitted to the voters on March 4. The cost of installing the system is estimated at $2,500,000.

SEATTLE, WASH.—Contracts for equipment for the municipal railway have been awarded as follows: Control and trolley equipment to the Westinghouse El. & Mfg. Co. at $21,702, and switchboard and apparatus at $4,000. All bids for two 400-kw transformers have been rejected and are not to be readvertised.

SPOKANE, WASH.—Extensions and improvements contemplated and already under way by the Spokane Gas Co. for 1913 call for an expenditure of $120,000. The company has awarded a contract for equipping the steam-driven machinery at the gas plant for electrical operation, to cost $20,000. The contract for energy to operate the machinery has been awarded to the Washington Wtr. Pwr. Co. A. N. Cantrill is manager of the gas company.

ANTIGO, WIS.—Improvements will be made to the plant of the Antigo Tel. Co. involving an expenditure of about $16,000.

BRODHEAD, WIS.—The town of Brodhead is considering the purchase of the property of the Brodhead El. Co., owned by George M. Pierce. The State Railroad Commission has been requested to give a valuation of the property.

CHIPPEWA FALLS, WIS.—Automatic telephone systems are to be installed in Chippewa Falls and Eau Claire by the Chippewa County Tel. Co., at a cost of about $150,000.

DE PERE, WIS.—The De Pere El. Lt. & Pwr. Co. is considering changing its system from direct to alternating current.

NEW RICHMOND, WIS.—The New Richmond Pwr. Co. is contemplating the construction of a second hydroelectric power plant.

TWO RIVERS, WIS.—The Board of Water and Light Commission has recommended to the City Council an expenditure of $3,500 for the reconstruction of electric transmission lines and the erection of additional lines to supply electricity for motors. Joseph L. Klein is secretary of board.

EDMONTON, ALTA., CAN.—The City Council has adopted the commissioners' report recommending the installation of an ornamental street-lighting system, to cost approximately $186,050; included in the same report was the estimate for lighting the high-level bridge and the Jasper Avenue subway, amounting to $16,750 additional.

DUNCANS, B. C., CAN.—Bids will soon be asked for by Ducane, Dutcher & Co., consulting engineers, Rogers Building, Vancouver, B. C., for the construction of a hydroelectric power plant at Skutz Falls for the city of Duncans, to cost approximately $45,000. The first installation will provide for 250 hp. Provision will be made for an ultimate installation of 1000 hp.

DAUPHIN, MAN., CAN.—We are informed that the town of Dauphin does not contemplate the construction of a power plant at present. The town has been discussing the question of developing the water-power at Meadow Portage, but nothing definite has been decided upon. J. W. Johnson is secretary and treasurer of the town.

DALHOUSIE, N. B., CAN.—Tenders will be received by Alexander J. LeBlanc, town clerk, until March 5 for the following work: Contract B—power house; contract G—booster pump: (1) steam pump; (2) turbine pump; contract H—two boilers; contract J—engine: (1) high-speed steam engine; (2) gas engine and gas producers; (3) Diesel oil engine; (4) crude-oil engine; contract K—electrical equipment and distribution system.

PARRY SOUND, ONT., CAN.—Preparations are being made to separate the street-lighting circuits from the remainder of the plant. The equipment required will include either a single or three-panel switchboard, with necessary oil switches, fuses, lightning arresters and ammeters, three constant-current transformers or three constant-potential transformers with regulators designed for 60-cycle, 2200-volt, three-phase system at 6.6 amp with rating of 16 kw; also cable suspension clusters for three or four tungsten lamps, single gooseneck pole fixtures, 80-watt and 60-watt tungsten lamps, 6.6 amp series. Tenders for the above will be asked by Feb. 15. G. Groves, superintendent of the municipal plant, has charge of the above work.

ST. CATHARINES, ONT., CAN.—P. B. Yates, of Toronto, representing the Ontario Hydro-Electric Power Commission, has quoted the St. Catharines' City Council a rate of $14 per hp per year for 2000 hp delivered at 13,000 volts. In addition to this it would be necessary for the city to erect a transformer station, the cost of which is estimated at $15,000. The Council has taken the offer under consideration.

MONTREAL, QUE., CAN.—The Board of Control has voted to appropriate $9,088 for 175 new arc lamps, which are mainly for new wards of the city.

MONTREAL, QUE., CAN.—The City Council has voted to appropriate $25,000 for the continuance of the work on the plans for laying all cables underground. The plans for St. Catherine Street are practically complete, and tenders for the laying of conduits will be called in February.

WILKIE, SASK., CAN.—Work will begin in April on improvements and extensions to the municipal electric-light plant and street-lighting system.

TEPIC, MEX.—The project of installing a large hydroelectric power plant on the Santiago River in the State of Jalisco, and the erection of a system of transmission lines to Tepic and a number of cities, towns and mining camps within a radius of 150 miles of the plant, has been revived by Rafael Pardo and associates. Application has been made to the government by Mr. Pardo and associates asking for the right to use 8000 gal. of water per second of the Santiago River, to be used for generating electricity.

New Industrial Companies

THE BACHLET MAGNETIC WAVE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Walter L. Vaughn, Gertrude A. Dickson and Charles Dampf, of Brooklyn. The company proposes to deal in electrical goods.

THE CONWAT ELECTRIC COMPANY, of Pittsburgh, Pa., has been incorporated with a capital stock of $5,000 for the purpose of conducting a general electrical supply business.

THE DETROIT COIL COMPANY, of Detroit, Mich., has been incorporated with a capital stock of $10,000 to manufacture spark and ignition coils. The incorporators are: Carl C. Cloverdale, Joseph R. Cloverdale and John F. Stobbe.

THE EDWARDS ENGINEERING & MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $220,000 by Douglas F. Johnson, Durwald E. Burchald and Mansfield Ferry.

THE UNDER-CUT DRILL COMPANY, of Boston, Mass., has been incorporated by W. G. Giddings, and A. R. MacKusick, of Boston, Mass. The company is capitalized at $50,000 and proposes to do a general mechanical and electrical engineering business.

New Incorporations

MODESTO, CAL.—The Farmers' Tel. Exchange Co. has been incorporated with a capital stock of $10,000 by W. H. Hemminger, S. N. McBride, F. L. South, M. Vincent and L. D. Scott.

REEDLEY, CAL.—The Reedley Tel. Co. has been incorporated with a capital stock of $25,000 by E. W. Crosby, D. C. Krehbiel, of Reedley; Dr. G. A. Therker, of Livermore; F. A. Baikin, of Dinuba, and Ira Dick, of San Francisco.

WAPELLO, IA.—The Wapello El. Co. has been incorporated with a capital stock of $25,000 by C. H. Walsh, G. H. Higbee, L. R. Sherill and Ora Vaught.

BIDDEFORD, MAINE.—The York County Pwr. Co. has been incorporated with a capital stock of $3,000,000 by George F. West, Maynard S. Bird, of Portland, and J. G. Shaw, of Biddeford. The charter of the company gives it the privilege of generating and distributing electricity and gas in York, Oxford and Cumberland Counties.

Trade Publications

PLANIMETERS.—The Industrial Instrument Company, Foxboro, Mass., in its Bulletin No. 71 deals with the Durand radial planimeters and includes a two-page sheet which contains instructions for their use.

SWITCHES.—The Fred W. Nason Company, 39 Cortlandt Street, New York, in a four-page folder invites ideas and plans for disconnecting switches. An illustration of a 10,000-amp direct-current switch is shown.

BALL BEARINGS.—"Ball Bearings in Machine Tools" is the title of a publication issued by the Hess-Bright Manufacturing Company, Front Street and Erie Avenue, Philadelphia, Pa. The subject is succinctly treated.

GAS PRODUCERS.—The Chapman Engineering Company, Mount Vernon, Ohio, illustrates and describes its rotary gas producer in an attractive catalog of twenty-four pages. The distinctive features of this apparatus, which was evolved after six years of continuous effort, are clearly set forth.

WIRING SPECIALTIES.—Bulletin 765, issued by Pass & Seymour, Inc., Solvay, N. Y., gives information to the trade respecting the change from one schedule to another of various devices. Bulletin No. 766 shows in a graphic manner how it is possible to make twenty-four combinations of P & S sockets from fifteen different parts.

SKYLIGHTS.—The G. Drouve Company, Bridgeport, Conn., in a recently issued eighty-page catalog effectively illustrates and describes its "Anti-pluvius" puttyless skylights. These skylights, which are used in many electric light and street railway companies and in a number of electrical manufacturing plants, give, it is stated, ample daylighting. The brochure contains an interesting illustrated chapter on the relation of daylight and ventilation to industrial efficiency and shows the constructive features of these skylights.

HOUSE LIGHTING.—Simplex Conduit, Ltd., of 116 Charing Cross Road, London, is issuing an interesting handbook entitled "Advice on Country-House Lighting," which has been prepared in answer to several requests for a publication dealing in simple language with the various uses to which electricity may be put in the average country house in which a private generating plant is installed. The plan adopted in the arrangement of this handbook has been to consider the rooms in the house one by one, dealing in each case with the various electrical appliances and means of lighting which apply to that particular apartment. With the aid of the book the householder can compile for himself a list of his requirements according to the outlay he intends to make. A section dealing with the types of private plants usually installed is included.

ALUMINUM VERSUS COPPER.—The British Aluminium Company, Ltd., 109 Queen Victoria Street, London, has recently issued an interesting pamphlet on the relative merits of aluminum and copper as conductors. Much of the material contained in the publication, particularly the principal characteristics of the metals, is of an engineering handbook nature, the data being comprehensive, clearly presented and illustrated by diagrams. Methods for calculating overhead transmission are described at length with references to a number of curves, charts and tables. Cost data for high-voltage overhead lines for equivalent sizes of copper and aluminum conductors and for various span lengths are also given, these, of course, applying to British conditions. The pamphlet is further illustrated with a number of views of typical installations of aluminum conductors.

Business Notes

LARGE ORDER FOR LAUNDRY MOTORS.—One of the largest orders ever placed for small motors has been given to the Westinghouse Electric & Manufacturing Company by the Hurley Machine Company, of Chicago, manufacturer of the Thor electric home laundry machines.

CENTRAL ELECTRIC COMPANY.—Mr. Charles D. Brainard and Mr. L. B. Van Nuys have succeeded to the ownership and management of the Central Electric Company, of Peoria, Ill., Mr. O. H. Norton, president and principal proprietor of the company for more than twenty years, having retired.

PROJECTOR SALES.—The Carlisle & Finch Company, 229 East Clifton Avenue, Cincinnati, Ohio, manufacturer of projectors, includes the following in one week's orders: One 14-in. searchlight to New Orleans, two 24-in. to Chicago, one 9-in. to Seattle, one 19-in. to Kansas City, one 19-in. to Pittsburgh, one 14-in. to Montreal, one 19-in. to New York City, one 19-in. to Louisville, one 14-in. to England, and two 19-in. to Detroit.

THE ELECTRIC TACHOMETER COMPANY has acquired all the rights, interests, good-will and title of the Electric Speedometer Company, of Washington, D. C., and has moved the latter company's plant to its own works at the southeast corner of Broad and Spring Garden Streets, Philadelphia, Pa. In this plant the company will manufacture electrical tachometers of various types, electrical speedometers, odometers and other speed indicating and recording devices. Mr. G. H. Taylor is president of the Electrical Tachometer Company.

THE MATTHEWS FUSE SWITCH is mentioned in an article by Mr. R. H. Pearson, superintendent of the inspection department of the Globe Indemnity Company, New York, in the January issue of the *Weekly Underwriter* as one of the best accident-prevention devices of recent design. Practically all of the large liability and accident-insurance companies, the manufacturers state, have placed their seal of approval on this fuse switch. Mr. Byron Cummings, the chief inspector of the Ocean Accident & Guarantee Corporation of London and New York, has authorized ths use of his company's name as approving and recommending the Matthews fuse switch to its central-station policy holders. Mr. Pearson, the author of the article above mentioned, has also granted similar permission and requested a sample to be placed in his exhibition of accident-preventing devices. W. N. Matthews & Brother report sales of this fuse switch aggregating over 2000 in 1912.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 28, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

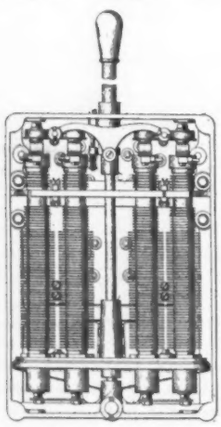
1,051,480. CURRENT CONTROLLER; L. Bradley, Muskegon, Mich. App. filed March 18, 1909. Variable-pressure resistance device.

1,051,481. ELECTRIC-CURRENT CONTROLLER; L. Bradley, Milwaukee, Wis. App. filed Nov. 20, 1909. A plurality of compressible variable-resistance elements.

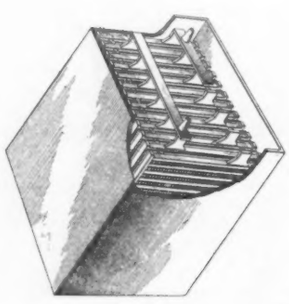
1,051,486. WINDOW GUARD; G. H. Camp, Leolyn, Pa. App. filed June 30, 1909. Normally open-circuit alarm system.

1,051,505. ELECTRIC FIXTURE; J. Le Moyne, New York, N. Y. App. filed Sept. 27, 1911. Pull socket-switch mechanism.

1,051,542. VOLTMETER SWITCH; C. H. Bissell, Syracuse, N. Y. App. filed Feb. 28, 1908. Hand-operated rotary type.



1,051,481.—Electric-Current Contol-ler.



1,051,816.—Electric Secondary Battery.

1,051,553. ELECTRIC-CLOCK MECHANISM; Le Grand C. Bush, Elkhart, Ind. App. filed Aug. 27, 1909. Operated by electromagnet and gravity.

1,051,556. PRODUCTION OF METALLIC BODIES BY MEANS OF ELECTRODEPOSITION; S. Consigliere, Genoa, Italy. App. filed Sept. 2, 1910. The metal while being deposited is subjected to hammer blows by small bodies.

1,051,557. CONTROL OF RAILWAY APPARATUS; F. B. Corey, Schenectady, N. Y. App. filed July 16, 1908. Return indication of electric motor-driven track switches.

1,051,580. PROCESS OF TREATING WOOD FOR USE IN ELECTRIC STORAGE BATTERIES; B. Heap, Clifton Junction, Manchester, Eng. App. filed Oct. 27, 1908. Deleterious substances are extracted by alcohol.

1,051,588. ELECTRICALLY CONTROLLED LOCK; W. H. Hollar and H. F. Balou, Philadelphia, Pa. App. filed June 3, 1909. Electric circuit and combination lock distinct from the time mark.

1,051,599. TELEGRAPH CONVERTER; I. Kitsee, Philadelphia, Pa. App. filed Dec. 4, 1908. Long-distance duplex system.

1,051,637. BATTERY SEPARATOR; H. Rodman, Pittsburgh, Pa. App. filed March 24, 1908. Fine sand and powdered glass fritted together.

1,051,638. SECONDARY BATTERY SEPARATOR; H. Rodman, Pittsburgh, Pa. App. filed March 24, 1908. Integral mass of porous glass.

1,051,645. SECONDARY OR STORAGE BATTERY; E. G. Steinmetz and E. W. Smith, Philadelphia, Pa. App. filed July 12, 1909. The grid is made up of rods.

1,051,675. METHOD AND MECHANISM FOR PRODUCING MUSICAL SOUNDS; G. Breed, Philadelphia, Pa. App. filed Sept. 23, 1909. Electromagnetically vibrated sonorous members.

1,051,743. ELECTRICALLY HEATED REACTION CHAMBER; J. MacKaye, Cambridge, Mass. App. filed March 20, 1906. For producing carbon chloride, etc.

1,051,749. ELECTRIC-LAMP SWITCH; N. C. Nispel, York, Pa. App. filed July 16, 1912. Incandescent lamp socket with adjustable resistance.

1,051,758. MAGNETIC SEPARATOR; J. C. Preslar, San Antonio, Tex. App. filed June 22, 1912. For extracting foreign matter from grain.

1,051,782. FLYWHEEL COMPENSATING SYSTEM; L. Thallmayer, Zurich, Switzerland. App. filed May 13, 1912. Motor-generator sets for hauling plants, etc.

1,051,810. APPARATUS FOR THE ELECTRICAL TREATMENT OF GASES OR VAPORS; W. T. Hoofnagle, Glen Ridge, N. J. App. filed March 12, 1912. Intermittent action for vacuum treatment.

1,051,812. ELECTRIC-RAILWAY SWITCH; D. W. Johnson, Saginaw West Side, Mich. App. filed July 15, 1911. Concealed motor with switch controlled by the train.

1,051,814. PROCESS OF MANUFACTURING POROUS-METAL BLOCKS; V. Löwendahl, Stockholm, Sweden. App. filed Nov. 11, 1909. A block of metallic powder and ammonium nitrate is heated.

1,051,816. ELECTRIC SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed Dec. 27, 1904. Porous retainers and anchoring teeth.

1,051,821. DYNAMO-ELECTRIC MACHINE; W. H. Powell, Norwood, Ohio. App. filed April 1, 1907. Commutating poles magnetically independent of the main-field yoke.